ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Vol. XXIV. No. 49.

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Railways, City Transit, Highways, Bridges, Tunnels and Canals, Water-Works, Artesian Wells, Irrigation, Sewerage and Municipal, Electrical, Contracting, Proposals Open, Manufacturing and Technical.

THE CANADIAN PACIFIC RY. is now said to be investigating two plans for getting to New York. One line would start across the State from near Brockville and run down the west side of the Hudson 15 miles inland of the West Shore Ry. The second scheme includes an all-American line from Buffalo to Winnipeg. Montreal correspondents say that "it is generally believed" that either or both of these lines may soon be built.

THE "FASTEST RAILWAY LINE" is claimed by the superintendent of the Chicago division of the Pittsburgh, Fort Wayne & Chicago R. R. As published, a special train last week ran 53 miles in 45 minutes, of which 11 miles were covered in 7 minutes, equivalent to 93⅛ miles per hour.

THE CHEAPEST RAILWAY TICKET issued is said to be one on the Berlin-Potsdam line, between Friedenau and Schoneberg. It is for school children, and costs one-half cent.

A DAMPER IN THE SMOKE BOX OF A LOCOMOTIVE is not a new experiment or a new idea, and Mr. PEEPLES, Master Mechanic of the Manhattan Ry. Co., in writing us about a damper in the front end of the smoke box of engine No. 47, which runs on the Forty-second St. branch of the New York elevated railway, gives the following particulars: As far back as 1850 Mr. ROSS WINANS, of Baltimore, found it necessary to devise some plan, other than opening the fire door, by which to cool down his soft coal burning engines; he applied a lever to the smoke box door by which the engineer could open and shut it at will from the cab. About 1873, when Mr. J. E. WOOTEN, of the Philadelphia & Reading R. R., got his dirt burning firebox to work properly, he found it to the advantage of the boiler to use some device to cool it down, and patented the damper in front door, similar to that on engine No. 47; it is in use on all locomotives having the Wooten firebox, except a few built at the Baldwin works for the Philadelphia & Reading R. R. while Mr. CUSHING was Superintendent of Motive Power on that road. The device consists of a number of triangular holes arranged in a circle, with a plate turning on a center to open or close these holes, the plate being operated by means of a rod from the cab. There is a similar device called the "Luttgen" damper which is around the bottom of the smokestack instead of in the front door. Either of these dampers is said to work to advantage on roads having runs of a few miles or more between stations, or when engines are in the round house, etc., under steam. On the engines of the elevated road, with their short runs between stations, it is not thought that much would be gained by their use.

ANOTHER COMPOUND LOCOMOTIVE has been built at the Schenectady Locomotive Works, Schenectady, N. Y., for the Michigan Central R. R. It is a ten-wheel engine, designed for fast passenger traffic. It has cylinders 20 × 24 ins. and 29 × 24 ins.; driving wheels, 74 ins. diameter; driving axle journals, 7½ × 8½ ins.; the boiler is of the extended wagon top form, with radial stays built to carry 180 lbs. working pressure; the shell is 58 ins. diameter; fire box, 96 ins. long by 42 ins. wide inside; 272 tubes, 2 ins. diameter, 13 ft. long. The total weight is 135,000 lbs., 99,000 lbs. on the driving wheels, and 36,000 lbs. on the truck. The tank has a capacity of 3,800 galls.

AN INTERLOCKING PLANT is being put in place at the Jersey City terminals of the New York, Lake Erie & Western R. R. by the Johnson Railroad Signal Co. It is expected to have the plant ready for service by Jan. 1.

A NEW FORM OF RAILWAY TRACK has been patented in England by Messrs. ROTHERY and WARBURTON, mining engineers. It consists of a Λ-shaped bridge rail, supported on chairs having a seat formed to fit into the hollow of the rail. The chairs are secured to the ties by spikes or bolts, like the chairs ordinarily used on English track. At joints the chairs are exceptionally long, and horizontal bolts pass through the legs of the rail and the saddle of the chair. It is claimed that the chairs may be attached to the ties at the proper distance apart for gauge, which may be done at the railway shops, and that the rails can then be laid by unskilled labor.

INDICATORS FOR AIR-BRAKE PISTON TRAVEL are coming into increasing use to present the too common loss of efficiency due to not taking up the slack promptly as wear of the brake shoes progresses. It is not at all uncommon for the entire travel of the piston to be exhausted before the brake shoes come to a bearing, making the brake useless. There are at least four such devices in the market, which are mechanically arranged to show the extreme piston travel, the indicator remaining in that position. One of the devices, in use on several Western roads, is a strip of iron fastened to one of the car sills adjacent to the cylinder, and marked off in inches, while an indicator fastened to the piston shows the travel of the piston only when the brakes are applied, leaving no registering mark. The other devices alluded to are patented articles, all of them having a permanent register, we believe, as it is desirable that they should. Two at least of these devices have been applied quite extensively, and cannot fail to be productive of good results. The Westinghouse Air Brake Co. informs us that they do not themselves furnish devices of this kind, so that they must be bought from the patentee or manufacturers; and while they would recommend the use of such devices in connection with the apparatus, they cannot, of course, put themselves in position to favor any one or the other of them.

NO ACCIDENTS IN A WHOLE YEAR is the report of the Georgia, Midland & Gulf R. R. to the Interstate Commerce Commission. The road was built in 1886-7 and is 98 miles in length. It has 7 locomotives, 10 passenger cars, and 135 freight cars, all of which are fitted with the Brooks pin and automatic coupler. Its earnings are about $150,000 and its operating expenses are about $100,000. During the year ending June 30, 1890, not a single employé or passenger received an injury, according to the officers' official report.

A NEW SHIP RAILWAY, patented by WM. SMITH, M. Inst. C. E., of Aberdeen, was exhibited at the Edinburgh Exposition. The exhibition plant had two tracks of 1 ft. 9 in. gauge each, with an over-all gauge of 7 ft. 2 in. The line was 1,200 ft. long, with grades of 1 in 20 to 1 in 75, and curves of 95 ft. radius. The rolling stock showed 4 compound trucks, each made of 4 ordinary bogie trucks. Resting on these compound trucks, and connected by pins, was the car for carrying the boat. This car is in 4 segments hinged together so as to admit vertical motion, but it is rigid horizontally. It approximates in outline to the vessel and on it are placed a series of india-rubber canvas bags, about 8 ins. in diameter, open at one end and closed at the other. These bags are filled with water to the flotation line and are placed side to side from end to end of the car, and on them the vessel rests. For a 1,000 ton ship 3 parallel tracks of 4 ft. 8½ in. gauge are deemed sufficient. Sir E. J. REED and Mr. W. R. KINIPPLE are said to have examined and to have approved of the system for transporting seagoing ships.

THE COST OF WARSHIPS, says the London *Times*, is as follows per ton: England, £30 5s.; France, £46 9s.; Russia, £87 5s. The price per indicated horse power is: England, £30 4s.; France, £56 and the United States, £67 2s.

THE U. S. NAVY, as shown in Secretary TRACY'S report of Nov. 29, has been increased, since March 4, 1889, by the following vessels, all of which are out of the contractors' hands and in commission: *Chicago*, 4,500 tons; *Yorktown*, 1,700 tons; *Petrel*, 870 tons; *Charleston*, 3,730 tons; *Baltimore*, 4,400 tons; *Cushing*, 99 tons; *Vesurius*, 970 tons; *Philadelphia*, 4,300 tons; *San Francisco*, 4,083 tons. During the present winter four more will be added to this list, viz.: *Newark*, 4,083 tons; *Concord*, 1,700 tons; *Bennington*, 1,700 tons, and *Miantonomah*, 3,815 tons. Four others were authorized prior to March, 1889, and are in a more or less advanced state, viz.: *Puritan*, 6,060 tons; *Amphitrite*, 3,815 tons; *Monadnock*, 3,815 tons; *Terror*, 3,815 tons. The *Maine*, 6,648 tons, has been launched. In all, during the last 21 months, nine new ships have been put into commission; four more are almost ready to go into commission; five are only waiting for their armor plate; seven have been built from the keel up, of which the *Texas*, 6,314 tons, and the *Monterey*, 4,000 tons, are almost ready for launching, and five cruisers are well advanced.

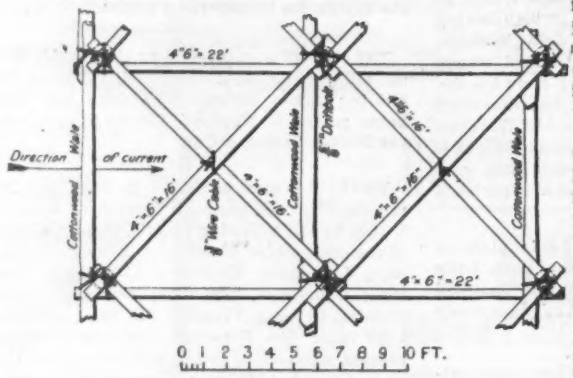
THE LARGEST CARRIER OF FREIGHT, for her size, is said to be the steel steamer *Maryland*, owned by the Inter Ocean Transportation Co., and built by the Detroit Dry Dock Co. The *Maryland* carries iron ore from Escanaba to South Chicago, and her largest cargo was 3,322 gross, or 3,737 net tons of ore. This cargo was taken on a draught of 16 ft., and did the depth of water permit, she could carry 4,000 tons. The largest grain carrier on the lakes is the steel steamer *America*, with a record of 111,507 bushels of corn carried from Chicago to Buffalo. These steamers are generally fast boats for freight carriers; the *Oswego*, this summer, made the 889 miles between Buffalo and Chicago in 54h. 16m., developing an average speed of 16.4 miles per hour.

THE NEW YORK AND NEW JERSEY BRIDGE, as planned by THOS. C. CLARKE, Chief Engineer, was made public on Dec. 1, as to location and general route. The bridge would cross the Hudson between 70th and 71st streets, run east to near Eleventh avenue, then turn south on a line 160 ft. west of Eleventh avenue to about 38th St. A grand union depot is proposed on the blocks between 38th and 39th Sts. and Eighth avenue and Broadway. This station would be 1,300 ft. long by 200 ft. wide, with room for 20 tracks and their platforms. One approach to this station would connect with the Sixth Avenue Elevated Road at 32d St. A second line would run from the Union Station toward the Hudson on a viaduct above the N. Y. Central & Hudson River R. R., and strike the surface at 79th St. From 79th St. this double track line would run along the river outside of the present tracks to 155th St.; then rise over the Central tracks and curve into a tunnel, half a mile long, and come out on the east side of the hill 18 ft. above the Manhattan Elevated Railway. Then it would cross the Harlem, northeasterly, to 162d St. and near there connect with the N. Y. & Northern and N. Y. & Hudson River railways. On the Jersey side 15 lines of railways could be connected with the bridge by tunnels and open cutting. The general details of the bridge, as given, speak of six tracks, a half-mile span, and average grades of 35 ft. per mile. The estimated cost is $50,000,000; of which $15,000,000 would be stock and $35,000,000 issued as bonds.

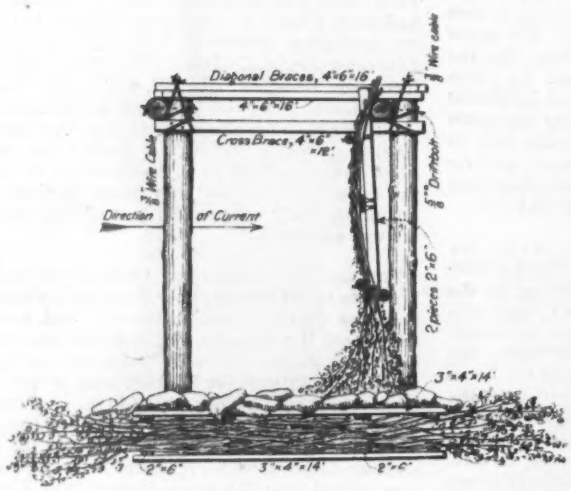
THE NEW CROTON AQUEDUCT IS PRACTICALLY completed, says the Commission at its meeting of this week. Chief Engineer FTELEY is directed to prepare a report covering the period Jan. 1, 1887, to Jan. 1, 1891.

Screen Dike and Jet Pile-sinking: Missouri River Commission.

The following matter and the illustrations given are taken from the last annual report of Mr. SAMUEL H. YONGE, Division Engineer Missouri River Commission, to Lieut. Col. CHAS. R. SUTER, U. S. Engs. and President of the Commission.



Plan of Bracing 3-Row Dyke.



Section. Front Elevation.

SCREEN MAT, AS USED BY THE MISSOURI RIVER COMMISSION.

The screen mat shown was used in the dikes at Little Platte Bend, Kansas City, etc. They were located approximately at right angles to the direction of the stream to be rectified, and their effect was to divert the current and concentrate the flow so as to generally shoal the part of the stream covered by them and to deepen the channel beyond the dike.

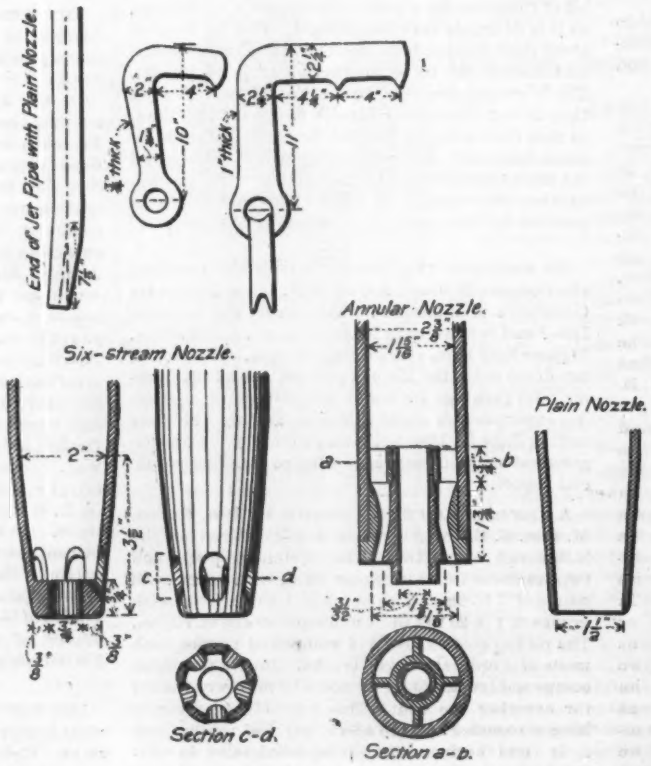
They consisted of either 2 or 3 parallel rows of piles thoroughly braced and protected from scour by a foot-mat, screens being placed on the upper side of the down stream line of piling. The rows of piles were spaced about 10 ft. from centers in bents of 8 or 10 ft. Three rows of piling and 8-ft. bents were used in deep water and where the dikes were exposed to the pressure of driftwood and a swift current. The main body of the dike was kept low to allow the floods to pass over it, but the shore ends gradually rose to the elevation of the bank. The piles were cottonwood, 28 to 42 ft. long and 12 to 20 ins., butt diameter. The rows of piles were braced in the direction of the dike by cottonwood wales, 6 to 10 ins. in diameter and 22 ft. long, each wale being attached to three bents and fastened to the piles by ⅝-in. square drift bolts and ⅝-in. steel wire cable lashings. The rows of piles were tied together by 4 to 6-in. yellow pine braces, fastened to the piles by 8-in. spikes and ⅝-in. cables. The whole structure is strengthened by a system of double intersection bracing of 4×6 yellow pine, which is also lashed and drift bolted to the wales.

The foot-mats are continuous throughout the length of each dike and consist of willow brush laid between two horizontal frames of 2 × 6-in. and 3 × 4-in. yellow pine fastened with No. 10 galvanized wire. The brush is held by the frames which are drawn together by cam levers provided with hooks; they are then fastened by wires passing through both frames. During construction the foot-mats are suspended over the water by wires running to spikes driven in the piles. When completed they are covered with stone, the wires are cut and more stone added to sink them to the bottom.

Different forms of screens were used as follows: (1) Bundles of brush placed vertically, forming a hedge, supported by the wales of the down-stream line of piles and intermediate posts. The butt end of the bundle was forced into the foot-mat and the upper end lashed by wire to the wales. (2) A thin wall was built of bundles of brush laid horizontally between pairs of posts driven through the foot-mat. The uppen ends of these posts were lashed to the wales and the brush held against the piling by the pressure of the current. (3) A wattling of brush bent around the piles and intermediate posts of the down-stream row.

The piles were sunk by means of a water-jet. On one of the pile-sinkers used three sets of leads were set up, 10 ft. from centers and 40 ft. high, and all braced together so as to form one frame, with an inclined ladder and back-brace to each set. After the crews become accustomed to the apparatus from 16 to 28 piles were sunk in one day by the older form of pile machine, and with the three-row sinker, from 20 to 34 piles per day. The material penetrated was usually sand; but pockets of gravel and layers of "gumbo" were sometimes encountered. The 1½-in. plain nozzle, for general service, proved most satisfactory. For the "gumbo" the annular nozzle proved best, and the 6-stream nozzle gave very satisfactory results in penetrating gravel.

The total number of piles driven was 1,243 and the average penetration was 18.9 ft. The actual cost of 2,159 lin. ft. of 3-row dike, including 727 piles, was $15,063.28, or $6.98 per lin. ft. A 2-row dike, 2,600 lin. ft. long, including 516 piles, cost in total $11,855.52, or $4.56 per lin. ft. These figures cover all expenses connected with the work, including labor, material, administration, tow-boat service and miscellaneous expenses.



JET. PILE-SINKING; NOZZLES, ETC.

The St. Clair Tunnel.

WITH INSET.

IV.

(Preceding articles published Oct. 4, Nov. 8, and Nov. 22).

THE CAST-IRON LINING.

At about the same time that the use of a shield was decided upon in the construction of the tunnel, it was also decided that the tunnel should be lined with cast iron. The suggestion that this material be used was made by Sir HENRY TYLER. The only existing tunnel lined with cast iron was the subway for foot passengers at Tower Hill, London, passing under the river Thames, built in 1868-9. The engineers of this tunnel were PETER BARLOW and J. H. GREATHEAD. It is only 8 ft. in diameter outside of the lining. Two iron lined tunnels, however, were in process of construction when it was determined to use cast iron on this work. One is the London & Southwark Subway, opened for traffic during the present month, and also built by Mr. GREATHEAD. The tunnel is 10 ft. in diameter, and it is lined with cast-iron plates 1¼ ins. thick. This work was described in ENGINEERING NEWS, Nov. 5, 1887. The other cast-iron lined tunnel is that now being built under the Hudson River at New York City. The lining for this was described and illustrated in ENGINEERING NEWS, March 15 and April 12, 1890. The lining is 19 ft. 6 ins. in outside diameter and 1¼ ins. thick. The St. Clair lining is 21 ft. outside diameter and 2 ins. thick. The reason for adopting the cast-iron lining at St. Clair is the same as that which has led to its use in other tunnels, namely, the fact that the material penetrated was soft and yielding, and was saturated with water. To secure safety and permanence, both during construction and afterward, it was believed that the cast-iron lining would be superior to one of brick.

In the accompanying drawings are shown a vertical section of the completed tunnel and detail drawings of the cast iron segments which make up the lining. Each of these segments is 5 ft. less $\frac{1}{16}$ in. in length, and is 18¼ ins. wide. The plate of the segment is 2 ins. thick. The flanges for the circumferential joints are 2⅜ ins. thick. The flanges for the radial joints are 2¼ ins. thick at the base and 1⅝ ins. thick at the point. Through each circumferential flange are cored 12 1-in. holes, spaced 4⅛

ins. apart, and bosses ⅝ in. high and 3 ins. in diameter are cast on the inner surface of the flange to compensate for the weakening due to the cored holes. Each radial flange contains four bolt-holes, spaced about 3 ins. apart. Besides these holes for bolting the segment together, a 1½-in. hole was cored through the shell of the segment and the loss of strength was compensated for by a 3¼-in. boss. This hole was to admit the cement grout, which was filled in to a thickness of 3 ins. between the lower half of the tunnel lining and the clay.

Each ring of the tunnel lining was composed of 13 of these segments and a smaller key piece 9⅛ ins. in circumferential length. To bolt the segments of each ring together, 56 bolts ⅞ in. diameter and 5⅛ ins. long, were required; while to bolt each ring to the preceding one just finished, 157 bolts ⅞ in. diameter and 8 ins. long were used. All the bolts were made of mild steel, and had square heads and hexagonal nuts. The latter were screwed up against a wrought-iron washer ⅛ in. thick and 1⅜ ins. in diameter. Part of the bolts were made at the Grand Trunk shops at Hamilton, but most of them were purchased of manufacturers in the United States.

The greatest novelty in the design of the segments is the means adopted for making the joints tight against leakage. For the radial joints the abutting surfaces of the segments were planed, and between them was placed a packing piece of seasoned white oak $\frac{5}{16}$ ins. thick. These were sawed to the exact size desired, and the bolt holes were bored ¼ in. larger than the bolt to allow for slight inaccuracies. After bolting in place, this wood packing piece rapidly absorbed water from the surrounding clay and in swelling closed the joint perfectly tight.

The only question with regard to the excellence of this packing relates to its durability. Whether or not, under the heavy pressure to which the wood is subjected, enough water will be absorbed from the saturated clay outside to preserve the whole piece from decay, is a question which can be definitely determined only by the test of service. In case decay and leakage at these joints should occur, however, it will certainly be no difficult matter to calk them with lead wire or similar material. The circumferential joints were made with a layer of P. & B. roofing as a packing and the abutting faces of the segments were not planed. The P. & B. roofing consists of coarse canvas covered with asphalt. It is made by the Standard Paint Co., of New York City. To provide for stopping any leaks which might develop at these joints, however, the inner edge of these abutting faces was cut away, leaving a groove all round each circumferential joint ½ in. wide and 2 ins. deep, which may readily be calked with lead in case leaks develop. Since the completion of the work a number of joints have been thus calked, and the tunnel will be almost absolutely water tight.

About one-third of the castings for the lining were furnished by the Grand Trunk shops at Hamilton, Ont., and the remainder by the Detroit (Mich.) Wheel & Foundry Co. The castings were of a high grade iron. The mixture charged in the cupola at Hamilton was 80 % old car wheels and 20 % Scotch pig. At the Detroit works some Southern irons were used in the mixture.

For the inspection of the castings as delivered, templates were made of iron plate ¼ in. thick, with openings to test the length and breadth of the castings. The maximum excess over the specified measurement allowed was $\frac{1}{32}$ in. The variation in weight allowed was from 1,000 lbs. to 1,050 lbs. The total weight of iron in the completed lining is 9,333 lbs. per lineal foot of tunnel, or 56,000,000 lbs. in all.

The castings were delivered from the cars to a machine shop erected on the site of the work, and the radial faces of the segments were planed. To do this with the least possible delay to the machinery a planer was provided having two tables and three beds. Thus while one table full of segments was being planed the segments were being placed in position and bolted on the other table. Each table held nine segments, which were placed side by side, convex face down, and both ends were planed at the same time. From 90 to 99 castings were planed daily.

The working drawings called for the plane of the face of these radial flanges to pass not through the axis of the tunnel but tangent to a $\frac{1}{16}$ in. cylinder having the same axis. This, of course, was to make parallel faces, between which the wood packing piece could be slipped. Inasmuch, however, as the difference between the outer and inner openings for the packing, if radial joints had been used, was only $\frac{1}{160}$ in., the difference between radial joints and parallel joints was hardly worth mentioning.

After the ends had been planed the segments were heated in a wood fire to a temperature of approximately 400 ° Fahr., and were then dipped in a bath of melted pitch. The wooden packing pieces were also dipped in melted pitch before being used. The segments were taken into the tunnel only as fast as needed.

THE SEGMENT HOIST.

It will readily be seen that to rapidly hoist these heavy segments, each of them weighing over half a ton, into various positions about the circumference of a ring 21 ft. in diameter required something more than an ordinary derrick. To perform this work the "segment hoist," shown in the accompanying engravings, and seen in perspective in the view of the shield published with our issue of Nov. 8, was designed by Mr. T. C. TEPER, Chief Engineer of the Hamilton Tool & Bridge Works.

This handy little crane was mounted on a shaft at the center of the shield, which was supported by plates and channels bolted to the bulkhead stiffeners, as seen best in the perspective view. By a screw gear moved by a hand crank, the head which picked up the casting could be slid toward or away from the center. Another screw shaft, whose end is seen just above the center in the perspective view, slid the crane upon the shaft toward or away from the shield; and a worm gear, seen at the left of the center, rotated the crane upon the central shaft. The hand crank which moved this gear was placed on the front side of the bulkhead so as not to obstruct the crane's circular path. With these three motions the operations of picking up, hoisting and placing in position the heavy segments could be rapidly performed. A cast-iron counterweight opposite the lifting arm assisted in the work of hoisting.

The end of the hoist which lifted the segment had four arms; and between each two was a turn-buckle, which moved pins in the arms to engage with the bolt holes in the segment. The details of the mechanism will be clearly understood by reference to the drawing.

To place a complete ring of lining in position, bolting it enough to hold it in place (leaving the rest of the bolting to be done by men who followed close on the shield and worked on light stagings), required about 45 minutes. The gang employed in placing the lining numbered 15. The ring was begun with the center segment at the bottom, and was built up on each side until the key piece was reached. This was held in place by the crane, while the wooden packing pieces on each side were driven in, and it was then bolted. The bolting was all done by hand with ordinary wrenches, as it would have been impossible to work socket wrenches in the contracted space.

THE SECTION OF THE COMPLETED TUNNEL.

In the accompanying drawing is shown a section through the completed tunnel, from which the arrangement of the 13 segments and key may be readily seen. The drawing, however, does not show the 3-in. ring of cement grout which surrounds the lower semi-circumference of the lining. The 1½-in. holes in each segment for injecting the grout behind the lining have already been referred to. The grout was made of White's (English) Portland cement, mixed just thin enough to pour. It was prepared as needed and simply poured into the space back of the lining through a funnel as each ring was completed. On the upper half of the lining the soft clay was suffered to settle down as the shield moved forward.

For temporary use, while the tunnel was being constructed, about 2 ft. of the excavated clay was filled in on the floor of the tunnel, and on this was laid the ties and rails for a double track, narrow gauge tramway, worked by horses, over which the excavated material was drawn out and the tunnel lining, etc., was taken in. After the completion of the tunnel, this clay was taken out and the whole tunnel was thoroughly cleaned. The lower half was then lined with brick laid in cement mortar to a thickness equal to the depth of the flanges, and brickwork was laid to receive the timber for the permanent way as shown in the drawing. The whole was then given a coating of neat cement mortar 1 in. thick. All surfaces of the iron lining on the lower half of the tube are thus well covered with cement. It was considered necessary to thus carefully protect the iron from corrosion on account of the large number of refrigerator cars passing through the tunnel. The drippings of brine from these cars would very rapidly corrode the iron if it were unprotected.

To protect the upper half of the lining from corrosion it was thoroughly cleaned and given a coat of asphalt paint.

The arrangement of the stringers, ties, guard timbers and rails for the permanent way is shown in the drawing. All the timber was of yellow pine, injected with 16 lbs. of creosote per cu. ft., and was furnished by the Eppinger & Russell Creosoting Works, of New York City. The total amount used is 264,000 ft. B. M., and 6,000 ties 8×8×9 ins. The ties are spaced 6 ins. apart, and are notched 1 in. into the stringers, thus making a very solid floor, which will effectually protect the tunnel lining from injury in case of derailment. The rails used in the tunnel were rolled by the Barrow Company, of England. They weigh 100 lbs. per yd., and are of the old "Goliath" section, brought out by Mr. C. P. SANDBERG in 1886. The new section of the "Goliath" rail was illustrated and described in ENGINEERING NEWS, Nov. 9, 1889. The old section, used in the St. Clair tunnel, compares with the new as follows:

	Old section.	New section.
Height, ins.	5¾	6
Flange width, ins.	5⅛	5
Head width, ins.	2⅝	3
Head depth, ins.	1⅞	1¾
Radius of top, ins.	6	8
Radius of corner of head, ins.	⅛	⅛
Thickness of web, ins.	½	⅝
Per cent. metal in head	43.5	45.5
" " web	23.9	22.
" " flange	32.6	32.5

Each rail has the sides of the head vertical and a fishing angle of 15°. It should be explained that the narrow base of the new rail is due to the fact that it is designed to be laid upon a tie plate.

The Barnes Feed Water Heater and Purifier.

The feed water purifier patented by Mr. J. B. BARNES, Superintendent of Motive Power and Machinery of the Wabash railroad system, and illustrated in ENGINEERING NEWS of Aug. 9, has since that time continued to give the most satisfactory results.

Mr. BARNES has applied this device to quite a number of his engines, and equips with it all those that go into the shop for general repairs, while several other roads are experimenting with it. At Tilton, Ill., the ill effects of bad water in the shape of very hard scale are felt to a greater degree than elsewhere on the Wabash R. R. Engines engaged in switching duty at that place have hitherto been stopped for the removal of flues, after, at the most, six months' service, and during this period boiler-makers have to be constantly in the fire-box, rolling, caulking and plugging flues.

To give it the most severe test Mr. BARNES sent to Tilton, over seven months ago, a switching engine equipped with his device. He states that no trouble from leaky flues has yet been encountered, and except for the purpose of removing a tube for inspection after six months' service, no boiler-maker has been inside the fire-box. The tube referred to was taken out by order of Mr. BARNES, to satisfy himself as to the internal condition of the boiler at a period when, without the purifier, the engine would have required the removal of all the tubes. He found the tubes covered with a very thin, friable scale, and the threads of the stay-bolts were as distinct as when the engine was first placed in service, while there was nothing on the crown sheet. The blow-off cock under the waist of the boiler had been used for a few seconds six or eight times a day, and effectually kept the annular space free from all accumulation of foreign matter. Mr. BARNES proposes to keep this engine at Tilton until it has been in continuous service for twelve months, when he will have it shopped and thoroughly overhauled.

The result of the examination will be exceedingly interesting.

It has been found desirable, in order to insure the thorough removal of mud that settles in the legs of the fire-box, to use two blow-off cocks, one in each side, or in the front and back water-space.

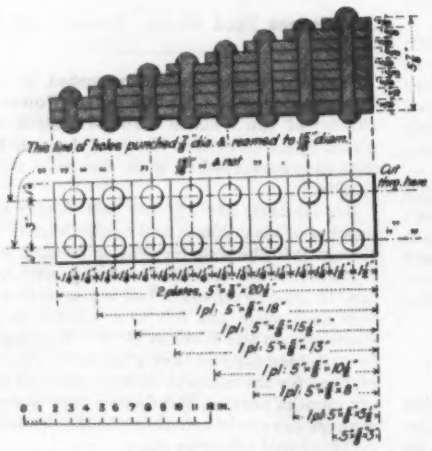
The immediate result of the use of the purifier is that engines are being run at least ten times longer before they are washed out, which is done after they have run 10,000 miles. This enables the master-mechanic to obtain more mileage from his engines in a given time, and upon the Wabash R. R. engineers running engines equipped with the purifier have been drawing more pay per month on this account than men upon the same division running engines not so equipped.

It is stated that engines with Mr. BARNES' device steam more freely and feel the effect of the injector much less than other engines, as it seems reasonable that it should. They are also proving, as might have been anticipated, more economical in coal consumption, as the heating surfaces are kept free from scale. The result of the extended use of the purifier will be increased life of tubes and fire-boxes, and consequent corresponding reduction of engine repairs.

Master mechanics have so frequently been disappointed at the outcome of experiments with the many patented appliances and nostrums said to prevent the accumulation of scale in a boiler, that it is with difficulty they can now be induced to try anything new, but judging by the records on the Wabash R. R. they need not hesitate to give Mr. BARNES' radically new device a thorough trial. The information we give above is not from Mr. BARNES, but from an entirely disinterested outsider who obtained the information at our request and in our behalf. We are happy to find that the good opinion of the device which we formed and expressed last summer, when we first saw drawings of it, is being justified by results.

Riveting Tests.

The accompanying illustrations show the results of some tests recently made for Mr. CHAS. W. BUCHHOLZ, Engineer of Bridges and Buildings, New York, Lake Erie & Western R. R., by the Union Bridge Co., at their Athens shop. The object of the tests, as will be readily seen, was to determine the effect of thickness of metal or length of rivet on hand and machine riveting respectively. To further vary the tests, both reamed and unreamed holes were used, so that there are four cases illustrated, viz.:


The line of holes punched ⅞" dia. & reamed to ⅞" diam.
Cut thro. here
2 plates, 5"×⅜"×20½"
1 pl. 5"×⅜"×18"
1 pl. 5"×⅜"×15½"
1 pl. 5"×⅜"×13"
1 pl. 5"×⅜"×10½"
1 pl. 5"×⅜"×8"
1 pl. 5"×⅜"×5½"
0 1 2 3 4 5 6 7 8 9 10 11 Ins.

Working Drawing from which test samples of riveting were made.

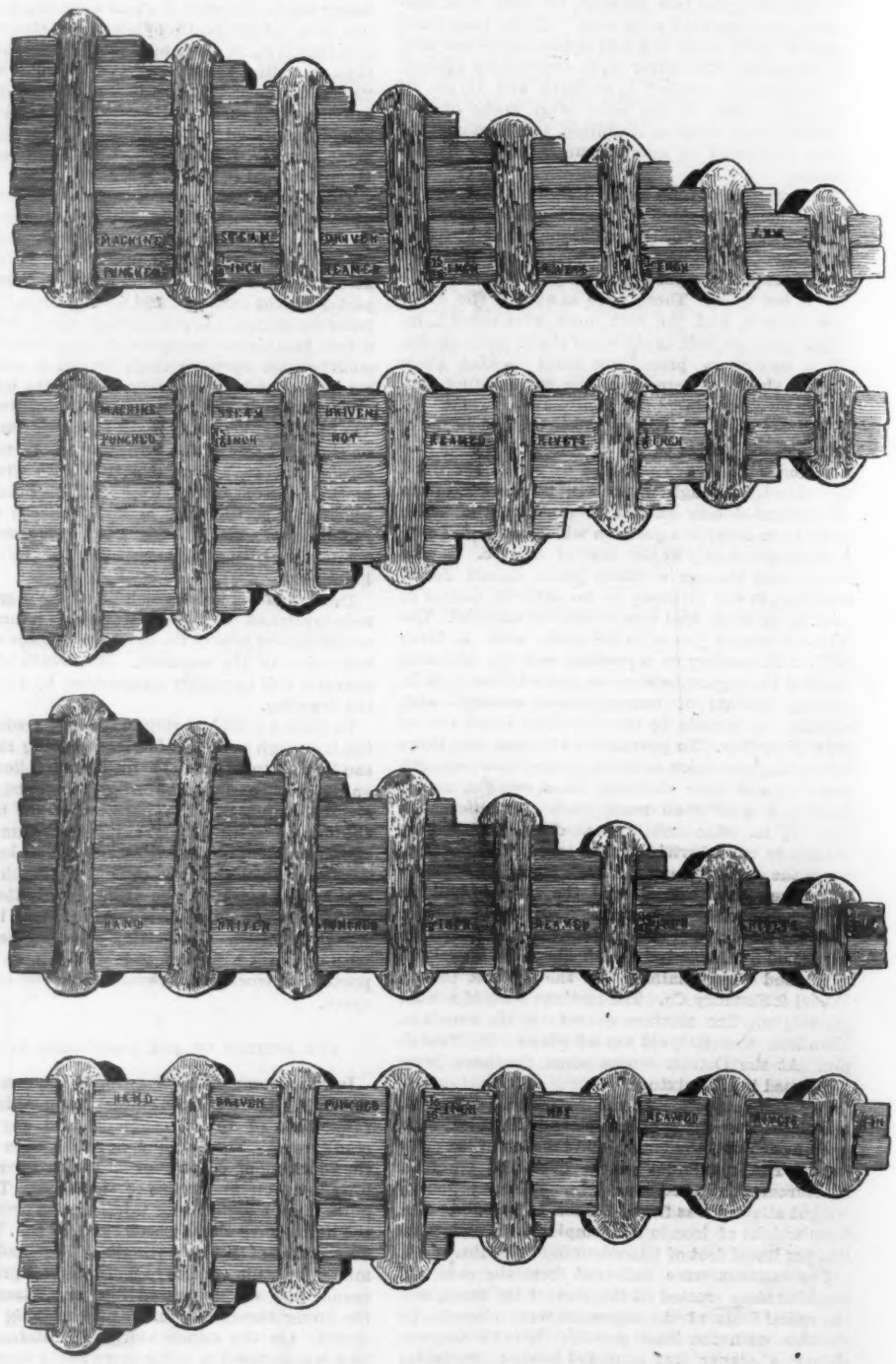
Machine steam driven:
1. Punched ¾ reamed ⅞ } rivet ⅞
2. Punched ⅞ not reamed }

Hand driven:
3. Punched ¾ reamed ⅞ } rivet ⅞
4. Punched ⅞ not reamed }

The tests were made by cutting two sets of plates, all 5 ins. wide, the lower two 20½ ins. long, and the upper one 3 ins. long; the two lower plates being ¾ in. thick, and all the others ⅜ in. The thickness for riveting varied, therefore, from 1⅛ ins. up to 5⅜ ins. Each of these piles was punched for two rows of rivets, 3 ins. apart between centers and 2½ ins. pitch longitudinally, all as shown in the small cut herewith.

The plates were then riveted together and planed to the center line of rivets. Just before the last cut was made on the planer, however, the surface was covered with paint, so the last cut left the planed surface bright except the flaws and indentations at the rivets, which remained dark.

The results are very significant, and are shown with accuracy in the accompanying engravings, which may be assumed with some confidence to show about the best results which are attainable with both machine and hand riveting. In fact, another set of plates like this was made at another shop, and a good one, with results so unsatisfactory that we are unable to spread them before our readers. The conclusions drawn from these tests (which every engineer can draw for himself from the engravings, however, as well as if he had the samples before him) were, that reaming for hand-driven holes was important when three or more plates were to be riveted together, and that about five times the diameter of the rivet was the utmost for which proper filling of holes could be counted on.



TESTS OF RIVETED PLATES, N. Y., L. E. & W. R. R.

The Strength of Manila and Hemp Ropes, and Rope Power-Transmission.

BY T. SPENCER MILLER, M. E.

Different authorities give the following formulas for the ultimate strength in lbs. of hemp ropes (C. representing the circumference of the rope in inches):

UNWIN, 688 C^2; MOLESWORTH, 627 C^2; KARL V. OTT, 612 C^2; RANKINE, 448 C^2.

TRAUTWINE denies the correctness of any formula using a fixed coefficient for the strength of manila rope, and from a table in his "Pocket Book" may be calculated coefficients varying from 906 (for rope ¾ in circumference) to 423 (for rope 14 ins. in circumference). TRAUTWINE, HASWELL and NYSTROM all agree that hemp rope is stronger than manila, while CHAS. P. SHELLEY, in 1863, in the *Mechanic's Magazine*, notes some tests giving manila rope a much greater strength than hemp.

In the tables published by the makers and dealers in manila rope there is also great variance of opinion, and the following coefficients are given:

Jno. Boute's Sons, Cincinnati	1,000C²
Geo. B. Carpenter, Chicago	1,000C²
Sewell & Day Co., Boston	800C²
Lawrence Rope Works, N. Y.	750C²
Elizabethport Steam Cordage Co., N. Y.	750C²
Fulton, Bolhman & Co., Pittsburgh	750C²
Wm. Wall's Sons, New York	750C²
C. W. Hunt, New York	720C²

So much for the opinions of authorities. Let us now see what coefficients are indicated by actual tests of the ultimate strength (the coefficients being determined by dividing the ultimate strength in pounds by the square of the circumference in inches.)

Through the courtesy of JNO. C. TRAUTWINE JR., C. E., I have been enabled to compile the following table, showing the results of tests of hemp and manila ropes made at the Watertown Arsenal, and at the laboratory of Riehle Bros. in Philadelphia:

TESTS OF ULTIMATE STRENGTH OF ROPE.

Size, ins.		Ultimate Strength, lbs.				
		Watertown Tests.			Riehle's Tests. Manila.	
Circumference.	Diameter.	Govt. Manila.	Purch'd Manila.	Navy Hemp.	1873.	1889.
1¾	9-16				3,437	3,000
2	5/8	4,270	3,500		3,987	3,500
2¼	3/4				3,937	4,000
2½	11-16	7,460	6,000	4,880	6,075	5,800
2¾	7/8				7,958	7,000
3	1	9,650	7,300	7,040	8,233	8,500
3¼	1 1-16			9,580	10,625	10,500
3½	1⅛	11,200	10,750	11,600	12,375	12,500
3¾	1¼				12,812	14,500
4	1 5-16	12,960	11,980	12,520	15,125	16,500
4¼	1⅜			14,500		
4½	1½	16,800	13,480	15,840		

Column 3 gives a coefficient of 1,068 for a rope of 2 in. circumference, and for 4-in. circumference only

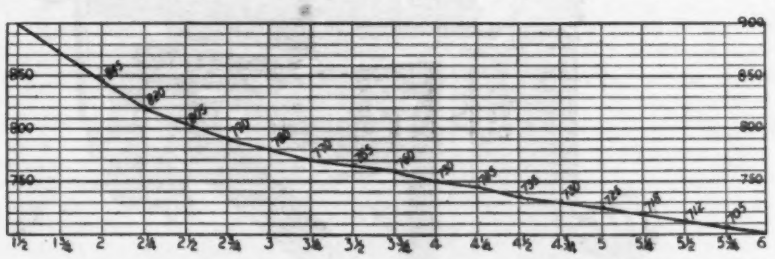


DIAGRAM SHOWING CURVE OF COEFFICIENTS USED IN CALCULATING ULTIMATE STRENGTH OF MANILA ROPE.

830. Column 4 shows a coefficient of 875 for 2-in. circumference, and 666 for 4¼-in. circumference.

Column 5 shows a coefficient of about 800 on the smaller sizes and 700 on the larger sizes, while the test on 15-in. circumference rope gave a coefficient of 543. Column 6 also shows a smaller coefficient for the larger diameter. Column 7 shows a coefficient of 980 for 1¾-in. circumference and 1,031 for 4-in. circumference, and is the only record of tests I can find showing an increasing coefficient. As it is only one case in four, I naturally adhere to the majority and think a variable and decreasing coefficient should be employed.

In 1883 W. T. DURFEE wrote an article for *Mechanics* on "*The Strength of White Manila Rope*," in which he quotes a "master rope maker" as giving a rule of thumb as follows: "Each yarn of a new white manila rope will sustain a hundredweight" (112 lbs.), and he remarks that this rule agreed well with recent tests by Riehle Bros. Both of the tests and this theory show a decreasing coefficient; and the tests of rope 1¾-in. circumference, gave about 1,100 as a coefficient, and 3½-in. rope gave about 900.

The results of these tests are at least sufficient to throw great doubt upon the accuracy of current formulas; and I venture to give the following diagram representing a curve of coefficients which I believe is about the right curve for average cases.

Using these coefficients, the following table gives the ultimate strength of manila rope up to 2 ins. diameter:

Diameter.	Circumference.	Ultimate strength.	Coefficient.
1/2	1½	2,000	900
5/8	2	3,250	815
3/4	2¼	4,000	820
7/8	2¾	6,000	790
1	3	7,000	780
1⅛	3½	9,350	765
1¼	3¾	10,500	760
1⅜	4¼	13,500	745
1½	4½	15,000	735
1⅝	5	18,200	725
1¾	5½	21,750	712
2	6	25,000	700

At the recent meeting of the American Society of Mechanical Engineers at Richmond, Va., the author of the above paper submitted a discussion of Mr. C. W. HUNT'S paper on "Rope Driving." Mr. HUNT'S paper was reprinted on page 447 of our issue of Nov. 15. We condense Mr. MILLER'S discussion as follows:

The paper by Mr. HUNT gives the ultimate strengths of ropes as 720 C² (C representing the circumference of the rope in inches). The result of tests made by the U. S. Government leads one to believe that while 720 is about the right coefficient for rope 1 in. in diameter, the coefficient for rope 2 ins. in diameter should be much smaller, and that for rope ½ in. in diameter, much larger.

In England hemp and manila ropes have been largely superseded by ropes of cotton; and I am satisfied that one reason for this is that dry manila ropes wear out too fast, while lubricated ropes give too low a coefficient of friction. The angle of 45° for the groove has been in use for 33 years, having been first introduced by JAS. COMBE in Belfast, Ireland; but if we are to use tallow-laid or other lubricated ropes, we should certainly use a sharper angle in the groove, especially in the American system, which employs the use of a continuous rope with many wraps.

Mr. HUNT'S formula,

$$\frac{\text{Tension of driving side of rope}}{\text{Tension of slack side of rope}} = 2,$$

implies a coefficient of friction of only .10. But I have obtained a coefficient of friction of .26, and have found one authority giving .28. REULEAUX advises for single line transmission, 30° angle of groove. RAMSBOTTOM, an English engineer, and Yale & Towne use a 30° groove in transmission wheels of travelling cranes, and I hope to see the best American practice use 30° or 35° as a standard groove angle. The work done in pulling out a greasy manila rope from a 30° groove is not worth consideration, although we hear a great deal about the loss of power on this account.

I am strongly in favor of using the continuous rope system, and also of using smaller ropes than are recommended in Mr. HUNT'S paper. Again a factor of safety of 36, or even of 25, seems a factor to provide for blunders in engineering rather than a necessity for safety.

The most perfect small transmission I have ever seen (about 20 HP.) employs 5-16-in. manila rope on wheels 30 ins. in diameter, using a tension carriage. Rather than use large ropes, I think it wiser to replace small ones oftener, for by so doing a great gain may be made in efficiency, thus saving fuel.

A large majority of failures in the continuous rope plan have occurred where the driving and driven sheaves were of widely different diameters, as for example, driving dynamos, or driving a line shaft from an engine fly wheel. As ordinarily installed the ropes will not pull alike, and by calculation or by experiment we may find one rope pulling twice or three times as much as the others on the sheave. It is no wonder, if this defect cannot be cured, that engineers advise a factor of safety of 25 or 30.

An installation designed by the writer some two years ago for J. K. RUSSELL, of Chicago, employs an engine driving sheave about three times the diameter of the driven sheave. To equalize the pull on the different ropes the grooves of the large driving sheaves were made with an angle of 0° and those of the small sheave with an angle of 45°. This change of groove angle has entirely remedied the unequal pulling complained of. It was arrived at by the following course of reasoning:

It has been observed that in sheaves of the same diameter, by the use of a proper tension weight, the ropes may all pull alike; while, where the sheaves are of unequal diameter, the pull is unequal. The only difference of conditions in the two cases lies in the different arc of contact of the rope on the two sheaves, which leads to a greater frictional hold of the rope on the large sheave. To equalize the frictional hold on the two sheaves we may sharpen the angle of the small sheave or increase the angle of the large sheave. For instance, in dynamo driving I would advise 45° for the driving sheave and as sharp as 30° for the driven sheave. Of course, the proper sheave angle can be arrived at by calculation, assuming a coefficient of friction of 29 as being about a proper medium between extremes. The above described improvement is the subject matter of a patent recently allowed the writer.

The Cost of Pumping at the Montreal Water-Works in 1889.

The relative cost of pumping domestic water supplies by steam and water-power and the cost of pumping, whether by steam or water, is always of interest and value to the profession. We therefore abstract the following from the last annual report of the Montreal water-works:

The total pumpage at the Montreal water-works, low-service station, for the year 1889, was 4,694,227,347 galls.,* of which 3,482,879,761 galls., or 74%, were pumped by water-power and 1,211,347,586 galls., or 26%, were pumped by steam power. The average static head against which the water-power pumps worked was 189 and the dynamic 193 ft., while the static head against which the steam pumps worked was 169 and the dynamic 184 ft. For steam pumping broken bituminous coal of the Scotch and Nova Scotia brands was used, the former costing $5 and the latter $3.85 (Canadian) per gross ton. Unfortunately the report does not state the amount of each kind of coal used. The percentage of ash at this station was 5.7.

A total of 4,826,390 lbs. of coal was consumed, which gave a duty, without deductions, of 46,181,100 ft. lbs. per 100 lbs. of coal, and lifted 251 galls. of water 169 ft. to the reservoir for every pound consumed.

The cost of raising 1,000,000 galls. 1 ft. was 7.8 cents for steam and .96 cents for water-power. Nearly all the steam pumping in 1889 was done by a 10,000,000-gall. Worthington pumping engine erected in 1886. The steam furnished this engine was from a battery of Heine boilers. The water-wheels are three turbines and one breast, driving pumps with a combined daily capacity of 10,500,000 galls.

The cost of pumping at the low service station, for each of the last 15 years, and the average for the period, both by steam and water-power, is given in the first two columns below, while the third column presents the cost of steam pumping at the high service station for each of 14 years, and the average for the period.

COST, IN CENTS, OF RAISING 1,000,000 GALLS. 1 FT. AT THE MONTREAL WATER-WORKS.

Year.	*Low Service.* Water.	*Low Service.* Steam.	*High Service.* Steam.
1875	2	11.9	...
1876	1.4	14.4	24
1877	1.58	8	25.3
1878	1.06	17	35.5
1879	.93	11.9	28.8
1880	1.2	12.3	27.4
1881	1.36	12.1	22.6
1882	1.18	25.8	25.6
1883	1.35	13.4	28.6
1884	1.24	21.1	31.8
1885	1.02	9.4	37.6
1886	1.1	13.8	25
1887	.92	11.7	18.7
1888	1.12	8.2	19.7
1889	.96	7.8	12.1
Averages	1.23 (15 y'rs.)	13.2 (15 y'rs.)	25.9 (14 yr)

It will be seen from the above that at the low service station the cost of pumping has been quite irregular, but that on the whole it has decreased, especially for water-power. This, so far as can be judged from the data in the report, is largely owing to improved machinery.

The Montreal high service re-pumping plant consists of a 500,000-gal. Worthington pumping engine built in 1875 and a 3,000,000-gall. Gilbert, erected in 1889. Water is pumped through a 12-in. main and a 1,750,000 gall. reservoir. In 1889 nearly all the pumping was done by the Gilbert engine. The total pumping for the year was 128,418,495 galls., against an average static head of 213, and dynamic of 265 ft. Broken and stove anthracite coal of Welsh and "American" brands was used, the cost being $5.20 per ton. The percentage of ash was 11.63. A total of 455,648 lbs. of coal was used during the year. The average duty obtained was 76,853,016 ft. lbs., without deductions, and 277 galls. were pumped for every pound of coal consumed.

The cost of pumping at this station increased, on the whole, from 1876 to 1885, after which it fell rapidly, until 1888. In 1889, as has been stated, the new Gilbert engine was put in operation and the cost for the year was but 12.1 cents for 1,000,000 galls. raised 1 ft. against an average of 25.9 cents for 14 years.

* Imperial gallons of 277.274 cu. ins. instead of United States gallons of 231 cu. ins. are always indicated.

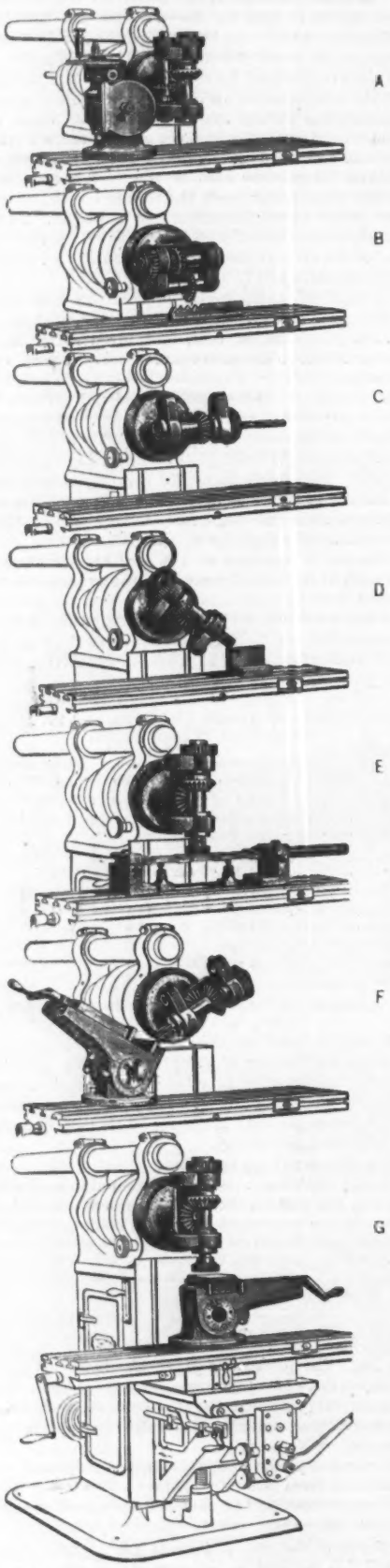
Heavy Universal Milling Machine.

The annexed illustrations show a new form of heavy, universal milling machine made by Pedrick & Ayer, of Philadelphia, Pa. It is designed for boring, drilling, facing, turning, milling, profiling, key-seating, rack-cutting to any length, gear cutting up to 5 ft. in diameter and other mechanical operations. Its chief claims of merit, are its great range of work, including work not done on other universal machines; its great capacity, convenience and precision.

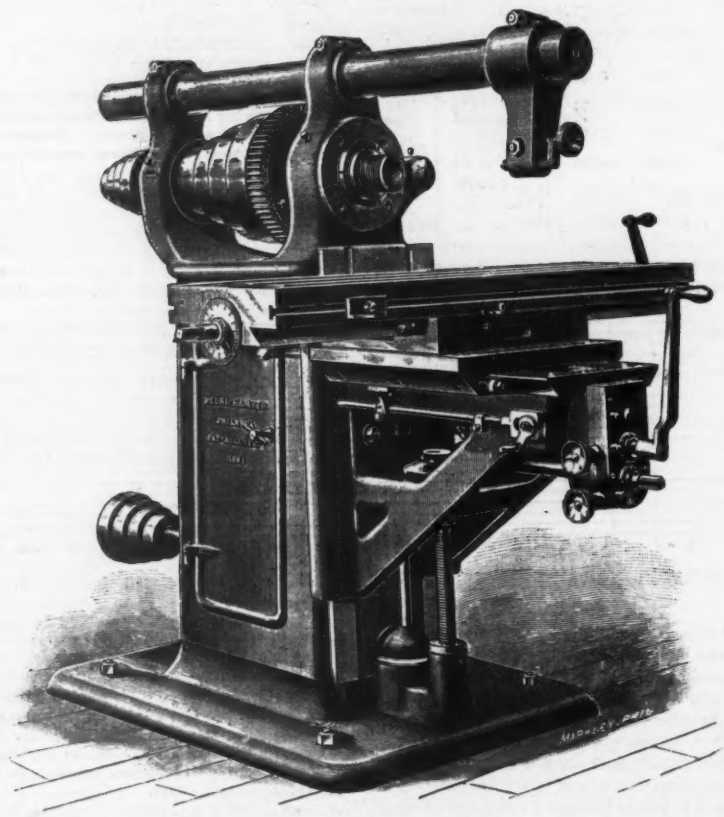
The gearing is made either internal or external, as desired. The spindle is of steel and runs in bronze boxes, with a front bearing of 3¼ ins. diameter by 6 ins. long, and a back bearing of $2\frac{5}{16}$ ins. by 5 ins., with easy adjustment for wear. The cutter arbor supporting bar has a range of 26 ins. beyond end of spindle, or it can be pushed back out of the way when a large piece of work is to be bored or milled. It has three feeds, vertical, horizontal, in line with spindle, and transverse, at right angles with spindle. These feeds are all reversible and operated by the handle shown in the cut near the cupboard board. The platen is 48x14 ins. and has three slots for ¾in. bolts on top, and is also slotted on both edges. The knee is carefully designed and constructed to withstand all strains liable to be brought upon it. The floor space occupied is 49x36 ins. and the height of spindle is 50 ins. from the floor. The weight is 5,000 lbs.

The second cut shows better than can be described some of the positions possible with this machine and its attachments, the latter also made by the same firm. Referring to the illustration, the arrangement shown at *A* indicates a method of cutting angle cutters and bevel gears; at *B* milling of locomotive quadrants, or ratchets for sand rod damper and injector handles. When the auxiliary shaft is in the position shown at *C*, the device can be used in a manner similar to the horizontal boring mill, or as a horizontal drill. By placing the auxiliary shaft at the angle shown at *D*, the recess for babbitt in locomotive cross head wings can be dovetailed to retain the babbitt. A most useful application of this device is shown at *E*, which represents the throttle lever in position, being milled for the various attachments.

There are several small details upon locomotives and many details in the locomotive shop tool-room which require hand work, such as can be done by this device in connection with the clamp vise, shown at *F*. This clamp vise is arranged to swing at any angle. It has a graduated base plate, and is held in position on the trunnion by two nuts, which clamp the body together, as seen in the cut. The graduated arc on the trunnion shows the angle at which the vise is set. The jaws are hardened steel, 8 ins. in length and open 5 ins. The small pieces which make up the throttle and reverse lever and link motion, as well as the plates and keys in connecting rods, often require a class of work known as shaping or "jig" planing. It is to meet the demands of this class of work that this useful milling attachment has been designed, together with the clamp vise, to be operated together, as shown at *G*. Not only is this device useful in large shops having a great variety of work, but in small shops as well, where the number of tools is limited; there are also a multitude of uses, other than those shown, to which this attachment can be put.



Universal Milling Machine, showing application and attachments.



HEAVY UNIVERSAL MILLING MACHINE. PEDRICK & AYER, MAKERS, PHILADELPHIA, PA.

Brakes for "Slip" Cars, and Communication Signals on English Railway Trains.

A peculiar practice in English railway operation is the uncoupling of the rear car of a fast through train while running, so as to let it stop at a station through which the train passes. This practice is called "slipping" a car, and is almost unknown in this country, although it was at one time in operation on the New York Central & Hudson River R. R., a car for Sing Sing being dropped from a through express train. Of course the uncoupling is done, or the "slip" made some distance before the station is reached, the car running on with its acquired impetus and being controlled by hand brakes. A few cases are on record of "slips" made too soon, the car in such case being left stranded on the track, and liable to cause an accident unless prompt means are taken to send back a flag, and to notify the nearest signalman. The practice seems to be rather dangerous, but is still operated and with success, under proper regulations and management.

The Board of Trade regulations now require that the last vehicle on a train must be braked from the engine, and that the guard traveling in this car must have the power of applying the brakes throughout the whole train. There is almost invariably a guard in the rear car of through trains, and always when that car is to be "slipped." The Vacuum Brake Co., of London, whose continuous automatic brake is in use on a large number of railways, has brought out a device, consisting of special cocks of simple construction, by means of which the continuous brake on the slip car may be under the control of the engine driver and guard until the slip is made. The coupling of the slip car has a hinged link, which is kept closed by a spring, and is opened by means of a

cord in the guard's compartment. The brake pipe is first disconnected, and then the car coupling. With the new device the guard can close the ends of the disconnected brake hose, and has a reserve of the vacuum brake power on the slip car available in emergency, as in the case of an obstruction on the track. Should the slip coupling break or accidentally become disconnected, the brake hose couplings will be pulled apart and the brakes automatically applied to the train and the detached car, and both brought to a stop, the same as in the case of the parting of an ordinary train.

The law in England requires that all trains running a distance of more than 20 miles without stopping must be fitted with a means of communication between the passengers and the engine driver and guard. A fine of $25 is imposed by law for the improper use of the communication, or its use without sufficient reason. The communication is generally a stout cord led along under the eaves of the roofs of the cars, through rings or small pulleys, and connected to the striking lever of a gong on the engine and in the guard's car or compartment. Electric communication, sounding gongs in the same way, and also displaying a small disk on the outside of the compartment to indicate where the call has been made, is in use on some lines, as on the London, Brighton & South Coast Ry. and Southeastern Ry. The Vacuum Brake Co., above mentioned, has introduced a new means of communication, which is operated in connection with the brake apparatus and is applicable to all trains fitted with the vacuum automatic continuous brake. In each compartment of every car, fitted underneath the parcels rack, is a handle attached to a copper chain which is connected with a rod running along under the eaves of the car, and with a valve on the brake pipe. When the handle is moved air is admitted to the brake pipe and partially applies the brakes; this calls the attention of the engine driver and guard, but should it for any reason be considered unsafe or inadmissible to stop the train at once, the driver can keep off the brake by using the larger ejector. By the same movement of the handle the rod above mentioned is turned, causing a small disk signal to appear at each side of the car; this signal indicates the car from which the communication has been made, and the position of the handle indicates the compartment, as the handle can only be moved back to its normal position by means of a special key carried by the guard. The Manchester, Sheffield, & Lincolnshire Ry. Co. has had a train running between London and Manchester fitted with this apparatus for more than a year, and it is proposed to gradually equip the whole of the rolling stock. It has been very little used in practice, but is said to have acted successfully when used. A series of tests was made recently by officers of the Board of Trade, with satisfactory results.

The Sewage of London, Paris and Berlin.

At a weekly meeting of the Balloon Society of Great Britain, held recently, Dr. C. R. DRYSDALE F.R.C.S., read a paper on the above subject. The lecturer demonstrated that the only rational and satisfactory method of treating the sewage of large cities was that now employed at Berlin, Paris, Croydon, and at a few other places on a less extensive scale, and its agricultural application on suitable soils. London presented a very bad example to other cities in the manner in which it dealt with its sewage by turning at least 150,000,000 gallons daily into the Thames at the outfalls of Barking and Crossness, and by unwisely and inadequately dealing with the solid matters. Glasgow and Dublin were even more lamentable failures in this respect. At present Paris had 1,500 acres of land cultivated by small proprietors who make use of 20,000,000 tons per annum to irrigate their farms. Some 3,000 acres have also been acquired at Achéres, which it is proposed to cultivate in the same manner, and other sewage farms were contemplated. The effluents were perfectly pure, and even drinkable. At Berlin the area of the sewage farms amounted to 19,000 acres. The crops grown were grass, roots, cereals, potatoes, cabbages and fruit. $16,055,000 had been borrowed for successfully dealing with the sewage of 1,500,000 inhabitants, while Sir R. RAWLINSON estimated that the present sewage experiments in London with over 5,000,000 inhabitants would cost $50,000,000 for no purpose whatever. The Paris Commission recently sent to Berlin reported a perfect success, and if the London County Council would send a commission their report must be equally satisfactory. The lecturer, in conclusion, suggested an experimental farm to be tried at Barking, which, if properly laid out and managed, would, in a short time satisfactorily test and assure the fertilizing qualities of the sewage, and a limpid effluent would flow into the Thames instead of a foul stream which made it more like a cesspool than a river.—*Industries.*

PERSONALS.

Mr. EDWIN H. HOBBS, late State Senator and Civil Engineer of the Amoskeag corporation, died on Nov. 27, at Manchester, N. H., aged 55 years.

Mr. W. R. LEHMAN, of Denver, Col., in charge of a Union Pacific Ry. surveying party, was drowned in the Sound, near Seattle, Wash., on Dec. 2.

Mr. J. W. PALMER, formerly Assistant Engineer on the Macon & Birmingham and Macon & Atlantic railways has been appointed Resident Engineer of the Macon & Atlantic Ry.

Mr. FREDERICK K. WING, late Assistant Engineer of the Columbus Construction Co., of Chicago, has entered into partnership with Mr. GEO. A. RICKER, Civil Engineer, of Buffalo, N. Y.

Mr. R. H. HOOD, formerly superintendent and engineer of the Davis Coal & Coke Co., of Davis, W. Va., has been appointed Chief Engineer of the Seaboard Air Line, with office at Raleigh, N. C.

Mr. A. W. COOK, late Principal Assistant Engineer of the Street Department, has been appointed City Engineer of Chicago. Acting City Engineer CHENEY returns to the charge of the Sewer Department.

Mr. A. A. JACKSON, General Superintendent of the New York & New England R. R., has resigned and the office has been abolished. The office of Superintendent of Transportation has been established and Mr. R. E. EAVENSON appointed to it.

Mr. S. M. FELTON, Jr., late First Vice-President of the New York, Lake Erie & Western R. R., has accepted the position of President of the East Tennessee, Virginia & Georgia Ry., with offices at Cincinnati, O.

Mr. J. P. ANDREWS, railway contractor, died recently at Cairo, N. Y. He was a member of the firm of Andrews, Warren & Co., who have the contract for the Buffalo & Geneva Ry. He built the Fourth Ave. tunnel and the Grand Central Depot, New York City.

Mr. WM. B. KNIGHT, M. Am. Soc. C. E., of Kansas City, Mo., of which city he was City Engineer for several years, was very seriously injured by being bruised and badly scalded in a railway wreck at Jacksonville, Ill., on the Chicago & Alton R. R., on the morning of Dec. 4. It is reported that he may not survive his injuries. Mr. KNIGHT was, previous to his removal to Kansas City, a resident of New York City, where he was deservedly popular in engineering circles.

Mr. MOORES M. WHITE died in New York City Nov. 30 at the age of 81. He was a native of Spencer, Mass. About 1840 he came to this city, entered the iron business, and was one of the pioneers among iron bridge builders. One of his early works was the bridge at Buffalo, known as the old Buffalo Creek Bridge, which was considered a great piece of engineering in those days. The bridge, which has a clear span of 160 ft., is still standing. Mr. WHITE also built many bridges for South American railroads. He was for several years Vice-President of the Second Avenue R. R. Co., and a director of the Christopher & Tenth St. R. R.

Mr. W. M. GREEN, General Manager of the Cleveland, Cincinnati, Chicago & St. Louis Ry., has announced the following changes: Mr. W. C. IRWIN, Chief Engineer, having resigned, the office is abolished and the Maintenance of Way Department is organized as follows: Mr. T. O. MORRIS, Engineer Maintenance of Way, in charge of the Chicago, St. Louis and White Water divisions; Mr. GEO. W. KITTREDGE, Engineer Maintenance of Way, in charge of the Cleveland, Cincinnati & Indianapolis divisions; Mr. W. A. MCCONNELL, Engineer Maintenance of Way, in charge of the Peoria division; Mr. C. E. IRWIN, Chief Clerk Maintenance of Way. The above offices to be located at Indianapolis, Ind. Mr. F. S. BALCOM, Engineer Maintenance of Way, in charge of the Cairo division; office at Mt. Carmel, Ill. Mr. F. WOODBRIDGE, Engineer Maintenance of Way, in charge of the Sandusky division; office at Sandusky O. Mr. J. B MITCHELL is Superintendent of Bridges.

THOMAS JEFFERSON WHITMAN, hydraulic engineer, died in St. Louis, Mo., Nov. 25, 1890. Mr. WHITMAN was born in Brooklyn, N. Y., in 1833, and commenced the practice of hydraulic engineering under Mr. JAMES P. KIRKWOOD, on preliminary survey for the Brooklyn water-works, and remained on this work until 1866. In the last-named year he was appointed Chief Engineer of the St. Louis water-works, and was in charge of the construction of the new system of that city from 1866 to 1872. In the latter year he was appointed Resident Engineer and City Water Commissioner, which position he held until very recently. After his retirement from office he acted as Consulting Engineer for Memphis, Tenn., Leavenworth, Kan., and several other cities in the West. He was also Consulting Engineer for the new sewerage system of Milwaukee. Mr. WHITMAN was elected a member of the American Society of Civil Engineers on Jan. 29, 1868, and was a younger brother of the poet, WALT WHITMAN.

NEW PUBLICATIONS.

—*Maximum Stresses under Concentrated Loads* treated graphically. By HENRY T. EDDY, C. E., Ph. D. Prof. Math and C. E. Univ. Cinc. New York: D. Van Nostrand Co. 8vo., pp. 100; 25 cuts and folding plate. $1.50.

This is a reprint from the Transactions of the American Society of Civil Engineers, and the general nature of its contents is correctly indicated by its title. As we have already noticed the paper we will not again review it in book form, further than to say that there are many different modes for accomplishing the results arrived at, and as doctors themselves differ so much as to which is best, though constantly working in this special field, we shall not attempt to decide between them. We doubt if special wheel-base computations serve any real good purpose.

—*Municipal Lighting.* By M. J. FRANCISCO. Read before the National Electric Light Association at Cape May, 1890. New York: National Electric Light Association. Pamph., pp. 19.

The contents of this paper were stated in our issue of Sept. 6, p. 210. Mr. FRANCISCO aims to show that figures indicating cheap electric lighting in cities where municipal ownership prevails are based upon faulty bookkeeping. Mr. J. P. BARRETT, City Electrician of Chicago, was to have made an answer to Mr. FRANCISCO's paper, in so far as it applies to Chicago, and this answer was to have been published and distributed with the paper under notice. Owing to a misunderstanding, Mr. BARRETT's paper does not accompany the above, but will be published separately by Mr. BARRETT. It should be read in connection with Mr. FRANCISCO's paper.

—*Report on Disposal of the Sewage of the City of Toronto.* By W. T. JENNINGS, C. E., City Engineer, Aug. 30, 1890. Pamph., pp. 11; folding colored map and sheet of profiles.

The general plan, as presented in this report, was outlined on p. 221 of our issue for Sept. 6. The map is on a large scale and shows the present and proposed systems. The profiles are of the high and low level intercepting sewers.

—*Report of the Water Commissioners of Melrose, Mass.*, for 1889. J. W. RILEY, Superintendent. Pamph., pp. 36.

This report contains 12 letters from various water-works engineers, contractors and superintendents regarding the relative merits of wrought-iron and cement and cast-iron pipe. The views are very divergent and will be commented upon in a future issue.

—*Report of the City Engineer of Somerville*, 1889. HORACE EATON, City Engineer. Pamph., pp. 53.

The report contains a description of the new high service system, together with the preliminary report of City Engineer EATON regarding it, and a report from M. M. TIDD approving the same. The report contains a detailed description of the sewers built in 1889, with the cost for each street.

—*Annual Reports of the City Engineer of Buffalo, N. Y., 1888 and 1889.* G. E. MANN, City Engineer. Pamph., pp. 109.

These reports consist wholly of tabular statements, which are very complete, regarding the work of the City Engineer, and are especially valuable for those interested in the cost of municipal engineering work.

—*Report of the Board of Water Commissioners, New London, Conn.* W. H. RICHARDS, Engineer. Pamph., pp. 32; three full page illustrations.

Appended to the usual report for the year is the report by Engineer RICHARDS, describing the work recently done for an additional supply. The illustrations show views of the new pumping station, high service motor and pump and tank. The motor is similar in principle to that in use in Burlington, Vt., described and illustrated in ENGINEERING NEWS, Vol. XVIII., p. 234.

—*Annual Reports Received.*—Water-works reports for Woodsville, N. H., Brockton, Brookline, Holbrook, Ipswich (Engineer's preliminary report), Leicester and Medford, Mass., Willimantic, Conn., Youngstown, O., Rock Island, Ill., and Montreal, P. Q. General city report for Syracuse, N. Y. City Controller's report for Pittsburg, Pa. Department of Public Work's report for St. John, N. B.

—*The Mechanics' Complete Library of Modern rules-facts, processes, etc., for Engineers, Mechanics, Electricians, etc.*—Compiled by Thos. F. Edison, A. M. and Chas. J. Westinghouse. Chicago, 1890, Laird & Lee, publishers.—This is a compilation, apparently made from various technical journals and publications, very crudely classified, if it can be said to be classified at all. The names of the compilers may accidentally coincide in form with those of Thomas A. Edison and George Westinghouse Jr.; but the

coincidence looks suspiciously like an attempt to connect these two well known men with the contents of the "Library."

—*Fifth Annual Report of the Commissioner of Labor 1889.—Railroad Labor.* CARROLL D. WRIGHT, *Commissioner.* Pub. Doc., 8vo, pp., 888, principally tabular matter.

The chief work of the Department of Labor since its organization in June, 1888, has been the collection of data relating to the cost of production of staple manufactures in this country and in competing countries. A part of the force which could be spared from this work has been employed in collecting statistics regarding railroad labor in the United States, the work being done between April, 1888, and April, 1889.

To publish full statistics for all the roads of the United States would have been impracticable, and so 60 different roads, having a total of 241,900 employés and including railroads in all parts of the country were selected for the investigation. The statistician has wisely adopted the State grouping arrangement to signify geographical location of roads; and he follows very nearly the State grouping used by "Poor's Manual" and by this journal. He makes a serious error, however, in trying to improve on this grouping by classing Virginia and West Virginia with the Middle States, and he puts Wisconsin with the Northwestern group instead of with Illinois, Michigan, Indiana and Ohio in the Central Northern group.

In point of accuracy the statistics presented must rank very high, for they have all been taken by agents of the Department direct from the pay rolls of the roads reporting. The names of the roads furnishing the information are not made public.

The chapter on the relations of employees and corporations opens with remarks on restrictions as to the use of intoxicating liquors. No less than 377 companies prohibit the use of intoxicating liquors on the roads under their control. About 25 companies furnish dwelling houses for the use of employees, and 149 provide dwellings for sectionmen, watchmen, etc., stationed in remote places.

Under the head of beneficiary institutions, it is stated that only 19 roads maintain such institutions; but about 75 companies are reported as giving more or less assistance to outside beneficiary organizations. The report then devotes many pages to a description of some of the principal beneficiary organizations, both those conducted by the companies and those conducted by the labor organizations being represented. The statistics regarding accidents collected by the Interstate Commerce Commission are quoted (See ENGINEERING NEWS, June 7, 1890) and the figures of the casualties to railway brakemen will bear repetition. A brakeman has only 31 chances in 145, or 1 in 4.7 of dying a natural death, and will be injured on the average once in each 9 years of service. Out of the 10,052 members of the Brotherhood of Railroad Brakemen in 1888, the total deaths in service were 114, with 53 total disabilities. Thus 1 in 60 of the members of the order suffers each year either death or total disability from the accidents of the service.

The question of employer's liability for accidents to employees is then fully taken up. Under the common law the employer is not liable where the injury was due to the injured man's own negligence or that of another employee. But legislation has reversed this common law principle in Great Britain and in many States. The acts by which this has been done are given or abstracted.

In Chapter III. the analysis of the statistics collected is given; and the first thing that takes the attention is the wide variety of designations under which the men are employed. Copies of the pay rolls of 60 roads show 1,106 different titles under which railway employees are classed. On these 60 roads 224,570 employees work by the day or by the month, but over half of this number were employed less than half the working days in the year. The complete figures are as follows:

No. of day's work in year.	No. of employees.	Per cent. of total.
25 days or less	56,404	25.1
26 to 50 days	25,684	11.5
51 to 100 days	31,014	13.8
101 to 150 days	18,861	8.4
151 to 300 days	44,331	19.7
301 to 365 days	42,719	19.0
Over 365 days (of 10 hours each).	5,557	2.5
	224,570	100.0

The above figures exclude employees paid by the mile, trip, piece, etc., as no figures were available to determine the length of time they had worked. These numbered 17,340. The surprising thing in the above table is that so large a proportion as 26.6 % of the time workers had employment only 50 days or less during the year. On the other hand, 21.5 % of the time workers were obliged to stick to their posts over 300 days in the year, and if the trip and mileage workers were included this latter percentage would doubtless be largely increased.

Concerning the vitally important matter of wages paid, the fullest information is presented. For the above 224,570 employees the following table is given:

Actual daily earnings or daily rate nearest to average daily earnings.	Employees. Number.	Per cent.
Under $0.21	656	0.29
$0.21- .40	817	0.36
.41- .60	1,867	0.83
.61- .80	3,352	1.49
.81- 1.00	9,539	4.25
Total under $1.00	16,231	7.22
1.01- 1.20	48,703	21.69
1.21- 1.40	48,476	21.59
1.41- 1.60	33,856	15.08
1.61- 1.80	25,608	11.40
1.81- 2.00	20,708	9.22
Total $1.01 to 2.00	177,351	78.98
2.01- 2.20	4,912	2.19
2.21- 2.40	7,416	3.30
2.41- 2.60	6,163	2.75
2.61- 2.80	4,443	1.98
2.81- 3.00	2,958	1.32
Total $2.01 to $3.00	25,892	11.54
$3.01 to $4.00	4,265	1.91
$4.01 to $5.00	674	0.30
$5.01 to $9.60	157	0.05
Total	224,570	100.00

Certainly no one with the figures of the above table before him can claim that railway salary lists are not fixed with economy and fidelity to the stockholders' interests In fact there are few industries in this country in which the pay is so small in proportion to the responsibility, the danger and the arduous nature of the work as it is in the railway service.

The most interesting tables in the whole book, however, are these which compare the average rates of wages paid in different sections to the principal classes of railway workers. The following is a condensed summary:

AVERAGE DAILY PAY AND AVERAGE ANNUAL EARNINGS IN LEADING OCCUPATIONS ON 60 RAILWAY SYSTEMS.

[*Employees paid by the mile, trip, piece, contract, or commission are excluded.*

Occupation.	New England Group.		Middle Group.		Southern Group.		Central Northern Group.		Southwestern Group.		Northwestern Group.		Pacific Group.		United States.	
	Daily rate.	Annu'l earnings.	Daily rate.	Annu'l earnings.	Daily rate.	Annu'l earnings.	Daily rate.	Annu'l earnings.	Daily rate.	Annu'l earnings.	Daily rate.	Annu'l earnings.	Daily rate.	Annu'l earnings.	Daily rate.	Annu'l earnings.
	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
Baggagemasters	1.78	557	1.58½	495	1.32	414	1.46½	458	1.10	345	1.79	561	2.00½	628	1.63	510
Baggagemen	1.67	523	1.46	456	1.42	445	1.61	504	1.49½	467	1.55	485	1.94½	608	1.51	472
Blacksmiths	2.36½	743	2.06	645	2.39	747	2.25½	706	2.67	836	2.26½	709	3.11½	974	2.19	686
Brakemen	1.80	561	1.73	542	1.26	395	1.86½	584	1.95	611	1.75½	549	1.96	613	1.78	557
Carpenters	2.14½	672	1.89½	593	2.10½	658	1.92½	603	2.32½	728	2.14	670	3.07	961	1.98	620
Conductors	2.82	883	2.54	795	2.58½	810	2.61½	818	2.92½	915	2.85½	894	3.00	939	2 63	824
Engineers	3.32½	1,041	3.15	986	2 91	910	3.07½	963	3.55	1,111	2.79¼	875	.....	.....	3.22½	1,009
Enginemen	3.24	1,014	3.20½	1,003	1.52	475	2.27	710	.....	.....	.....	.....	.....	.....	3 19	999
Firemen	1.89	592	1.72	539	1.29½	405	1.79½	562	2.04	639	1.90½	596	.....	.....	1.79½	562
Flagmen	1.24½	390	1.16½	364	.89½	280	.97½	306	.....	.....	1.02½	320	1.64½	515	1.13	354
Foremen	2.33½	731	1.81	566	1.66	526	1.81½	567	1.88½	589	1.78½	559	2.46¼	773	1.88	589
Laborers	1.51	472	1.23½	387	.88	275	1.21½	381	1.21	379	1.30	406	1.87½	586	1.26	395
Machinists	2.23	698	2.05	642	2.70½	847	2.25½	706	2.69	842	2.43¾	763	3.06¾	959	2.18	683
Masons	2.19	685	2.44	764	3.00	939	2.76	864	2.54½	796	3.00	939	.....	.....	2.45¼	768
Painters	2.01¼	631	1.88	588	2.02½	634	1.91½	600	2.42½	760	1.72	538	2.81¾	881	1.95	610
Switchmen	1.78	557	1.57	398	1.11	348	1.53½	481	2.30½	722	2.15½	675	2.20	689	1.50¼	471
Telegraph operators	1.42½	446	1.34½	421	1.50¼	471	1.47	460	1.67½	525	1.38¼	434	2.09¼	656	1.43¾	449

Among the notable points in this table are the high wages paid engineers, which seem certainly excessive if compared with those paid in any other department of railway service. Blacksmiths, machinists, masons and conductors are the only other employees who can earn over $2 per day, taking the country as a whole. The South shows its need of good workmen by paying very high wages to workers at trades and very low wages to the lower grades of labor. The Pacific States, on the whole, pay the highest wages to their employees.

An interesting table comparing rates of pay on British railways with American shows that the British engine driver gets $1.46 per day against the American's $3.22 The British fireman earns 91 cents per day while the American earns $1.79½. British "shunters" get 85 cents per day, while American switchmen, who are so prone to strikes, receive $1.50¼.

The popular impression that railway trainmen have long hours of duty is found on investigation to be exaggerated. A table is given showing cases of long hours of service or long runs, from which it appears that the cases where trainmen are on duty and actually on the train more than 12 or 13 hours hours at a time are very exceptional.

The 800 odd pages of tables which make up the body of the report seem to have been compiled with much care; but it would have made the report much more useful if more space had been devoted to digesting, summarizing and explaining this statistical matter.

—*Annual Report of the Chief of Engineers, U. S. A.*, 1890. Pub., Doc. 8vo, pp. 378.

The corps is shown to number in all only 112 officers, of whom 33 were engaged in river and harbor works alone, and 22 others partly on that and partly on fortifications; 19 officers were on detached service. As a curious evidence of the status of civil engineers in the service—an appalling list of the various duties and details of the various individual officers is given, occupying 20 pages of small type, with 3 to 30 items for each officer. At the end of all this there is one poor line for "U. S. Civil Engineer M. Meigs, on duty under the immediate orders of Major Mackenzie"! Not even his station or duty is deemed worthy of note.

—*Handy Lists of Technical Literature.* A reference catalogue of books printed in English from 1880 to 1888, inclusive, with a select list of books printed before 1880. The following parts are now ready: Part I. Useful Arts in General, Products and Processes used in Manufacture. Pp. 100; paper $1.50, cloth $1.75. Part II. Military and Naval Science, Navigation, Rowing, Sailing, Yachting, Shipbuilding, etc. Pp. 104, paper, $1.50, cloth, $1.75, Part III. Engineering and Mechanics; comprising Applied Mechanics, Machinery, Steam and Marine Engineering, Railroad Building, Construction, Engineering, Management and Practice, Civil Engineering, Surveying Leveling, Hydraulic and Sanitary Engineering, Sewerage and Drainage, etc., Mechanical Drawing. 8vo, pp. 168; paper $2.50, cloth $2.75. Part IIa. Electricity and Magnetism, Telegraph, Gas, etc., complete up to October 1890, will be ready about Nov. 10th, price about $1.00. If parts III and IIa, are ordered together a reduction of 15 per cent. will be made. Address F. E. Galloupe, 30 Kilby St., Boston, Mass.

TRADE PUBLICATIONS.

— *Electrical Catalogues.* Perhaps in no department of applied science is the scarcity of reliable books of reference, brought down to the present practice, so deeply felt as in the field of electrical apparatus. Recent works like "Electricity for Engineers," while excellent as far as they go, are too concise to enter into details. The different companies engaged in the manufacture of dynamos and motors have recognized this fact, and have prepared a large number of excellent catalogues, full of cuts and careful descriptions.

Among the best of these are the publications of the Westinghouse Electric Co. One of the books of this company is devoted to the alternating incandescent light system, and contains the following description of the development of that method of lighting:

The alternating dynamo, instead of causing a continuous flow in one direction, sets up merely a vibratory movement—a back-and-forth flow in the wire, the vibrations being many thousands in a minute. Here the usual analogy of electricity to hydraulics ceases, since the reversal of motion in a flow of water would be accompanied by a great loss of energy due to its weight. Electricity being without weight, there is no loss of this, or any other, character due to the reversals, while the possibilities dependent upon the abstract fact of an alternating or reversing flow are of the highest value.

The dynamo in its original and elementary form was an alternating dynamo, but the immediate purpose of the invention being to decompose water into its constituent gases, which, being burned, would produce light, the alternating current failed in practice on account of its non polarity. Hence arose the commutator, a most ingenious but complicated device. In its nature the commutator was an electric valve, the office of which was to reverse each alternate "alternation," thus turning them all in one direction, *i. e.*, into a continuous current. This continuous current, having polarity, was therefore applicable for the required purpose.

The early electricians, having thus familiarized themselves with the phenomena and application of polarity in the electric current, next turned their attention toward the decomposition of metallic solutions as applied to electroplating, etc. A great advance was made in this special department of electro-dynamics, and consequently when other problems, such as those connected with electric lighting and motor plants, called for consideration, the minds of electricians had become so fixed in the grooves of a necessarily continuous current that it occurred to no one to turn back and examine what were the possibilities of the original alternating current in the new fields. Thus the commutator came to be considered as much an essential part of the dynamo as the shaft or armature. When, however, Messrs. GAULARD and GIBBS so far divested themselves of the trammels of precedent

as to discard the commutator and experiment with the current as primarily generated in the armature, it was found for lighting purposes to possess advantages of the most revolutionary character.

To understand the alternating or converter system fully, it must be remembered that the term "continuous current" not only refers to a continuous direction of flow but also to a uniform intensity of pressure (voltage or electromotive force) in all parts of the system. Electricians have from the first recognized the pressing necessity of a voltage as high as possible, since the cost of the copper conductors is reduced in the inverse ratio of the square of the voltage employed. This voltage was fixed at 110 volts by the lamps, which, electrically speaking, is an extremely low pressure for distribution purposes; the dynamo must be wound to generate the same voltage and the wiring between the dynamo and lamps must be calculated to convey the required current at again the same voltage. Such a system is commercially known as the multiple-arc system and is applicable only to extremely short distances.

The next step in advance was the devising of the three-wire system. Without describing its action in detail, it is sufficient to say that it is merely a means of increasing the voltage in the dynamo and distribution system from 110 to 220 volts, while still retaining the 110-volt lamp. The full saving of 75% of the copper due theoretically to the increased voltage was never realized; the practical saving was from 30 to 60%, the former figure representing the best disinterested authority. To accomplish even this result, many new and complicated devices were necessary.

Since it is obvious from the preceding paragraphs that the best results are obtained by a lamp the voltage of which is as low as possible, and on the other hand by a dynamo and distribution system the voltage of which is as high as possible, we at once set up two opposing requirements. When science insists on a high voltage generation and distribution, and a low voltage lamp as the absolute condition of further progress, we are at once brought to consider the equally absolute requirement of a device to interpose between the high voltage in the circuits and the low voltage in the lamps, the purpose of which device shall be to convert or transform the high voltage necessary to perfect distribution into the low voltage necessary for perfect utilization. A system based on such a device becomes a "converter system," which in turn is dependent upon and only possible with an "alternating" current.

The converter is nothing more or less than an electrical reducing valve, permitting of a high distribution pressure on one side and a low service pressure on the other.

We have seen that the continuous current system is necessarily a one-current system in which the limiting condition is imposed by the lamp. On the other hand, the converter system is a two-current system on which there are practically no limitations whatever. The flexibility of such a system is apparent. For ordinary distances up to two miles, 1,000 volts in the distribution or primary circuit may be used, while from the same dynamo a portion of the current may be raised to 2,000 or 3,000 volts for the primary circuits to adjoining villages or other remote points. We may at the same time employ any desired voltage in the service or secondary circuits.

This alternating current system has been applied with much success to arc lighting, and another catalogue of the same company contains a full description of the dynamos and lamps employed in this service. These two publications together contain as thorough an account of the alternating system as any one, not a practical electrician, would need.

The Westinghouse Electric Co. also operates the United States Electric Lighting Co., manufacturers of direct current incandescent and arc apparatus; which is fully described in a 52-page catalogue. This company controls the Weston, Farmer and Maxim patents, and is noted particularly for the excellent character of its switches, meters and similar devices explained in their publication. A special pamphlet is devoted to the well-known Weston direct-reading voltmeters and ammeters. Another Westinghouse concern is the Sawyer-Man Electric Co., manufacturers of incandescent lamps and fittings, described in a pamphlet of 90 pages.

The Brush Electric Co., the pioneer arc light manufacturers for commercial purposes, issue a large 50-page catalogue of their machinery, containing unusually full tables of their dimensions, lighting or plating capacity, and horse power of arc, incandescent and electro-plating dynamos and storage batteries. An interesting statement made in this publication is that the first Brush machine, made in 1876, has been in steady use ever since that time and is now at work in Baltimore.

The Fort Wayne Electric Co., using the Slattery alternating patents, and the Eureka Electric Co., which controls the Loomis system, both publish valuable catalogues.

The publications of the Edison General Electric Co. are too numerous to be all separately noticed. A particularly valuable pamphlet contains brief instructions for operating dynamos in electric railway power stations, and those devoted to the Sprague motor and its applications are full of data regarding this favorite machine.

The catalogues of the Wenstrom Consolidated Dynamo & Motor Co. are very interesting. The company controls the American patents of Jonas Wenstrom, the well-known Swedish engineer, and has published a number of good cuts illustrating their dynamos and motors, together with descriptive matter of more than usual completeness. The gearing manufactured by this concern is also fully described, and its good service record will not seem so surprising after the account of its manufacture has been read.

The C. & C. Electric Motor Co. has a number of valuable publications; one in particular, devoted to the application of their motors to organ blowing, is very interesting reading.

All of the above publications contain an amount of information which it is at present next to impossible to obtain elsewhere. While allowance must always be made for a tendency toward exaggeration in trade catalogues the statements made in the pamphlets noted are, we believe, all borne out by facts.

—Electric Street Railways. Pamphlet, Short Electric Railway Co., Cleveland, O., contains a number of good process cuts of several railways operated by Short machinery, together with cuts and descriptions of the leading features of the dynamos, motors and trucks.

—Cypress Water Tanks and Cisterns and Water Supply Material. Pamphlet, pp. 78. Callahan & Lewis New Iberia, La. The firm which sends out this trade catalogue is located in the Cypress timber district of Louisiana and its specialty is water tanks made from this wood, which is asserted to be especially adapted to this purpose.

Viennot's Selected List of Trade Papers. Published by Jules Viennot, 504 Walnut St., Philadelphia, Pa. A useful list for advertisers, covering over 400 of the more prominent technical and trade journals in this country. The "list" includes the name and address of publisher, date of issue, size of journal, and the advertising rates, "as furnished by the publishers themselves."

—Gibbon Duplex Street Railway Tracks. Catalogue No. 1. Issued by the company of that name; Office, No. 1 Broadway, New York. This is a well digested and well illustrated exhibit of the advantages claimed for this new form of street railway track, already favorably commented upon in this journal of Nov. 15, 1890. The pamphlet shows its use on electric and cable roads, with full detail of all its parts and methods of construction.

SOCIETY PROCEEDINGS.

New York Railway Club.—The next meeting will be held at the club rooms in the Gilsey House at 2 P. M. on Thursday, Dec. 18. Mr. R. A. Parke will present a paper on "Brake Rigging."

The Railway Master Mechanics' and Master Car Builders' Associations.—The next annual conventions of both these societies are to be held in New York City. The Master Mechanics will meet on Tuesday, June 9, and the Master Car Builders on Monday, June 15.

Civil Engineering Society, Mass. Inst. Technology.—Meeting Nov. 20. Mr. H. E. Bradley read a paper on "The Erection of Iron Bridges," and Mr. C. W. Sherman, one on "The Disposal of Sewage at Worcester, Mass." A. L. GOETZMANN, Secretary.

New England Railroad Club.—The next meeting will be held Dec. 10 at the United States Hotel, Boston; subject, "The Best Form and Application of Brakes to Driving Wheels of Locomotives." Mr. L. M. Butler (N. Y., P. & B. R. R.), will open the discussion. Parties wishing to present any form of driving brake may do so by preparing a paper to be read at the meeting.

Northwestern Kansas Irrigation Convention.—An irrigation convention will be held at Oberlin, Kan., Dec. 10 to consider methods for irrigating the northwestern part of the State. A. H. MCGEE, Decatur, Kan., is chairman of the committee on arrangements for the convention. J. W. GREGORY, Prof. ROBERT RAY and Secretary MONIER of the State Board of Agriculture will take part in the discussion.

Liverpool Engineering Society.—At the meeting of this society at Liverpool (England) on Nov. 12, a paper was read by Mr. John S. Brodie, on "Water Pressure Engines."

The author, after a general introduction on the subject, dealt with some water pressure engines which had recently been erected at the Whitehaven water-works for the purpose of pumping water to a portion of the town which is situated at a high level. He stated the conditions under which they had to perform, and then proceeded to describe the engines and pumps in detail, giving statistics of their performance, together with the first cost and the actual cost of working.

Central Railway Club.—A meeting was held on Nov. 26 at the Iroquois hotel, Buffalo, N. Y. The principal discussion was on a circular recently issued by the New York Central & Hudson River R. R., to accept cars with M. C. B. couplers having the knuckles broken. Several members criticised the circular and thought cars should be carded for this defect. This brought up the general question of couplers, and Mr. Adams, of the Boston & Albany, made a bitter attack on the M. C. B. type, which was ably defended by Messrs. Bissell, Griffith, Mackenzie and others. A committee of five was appointed to prepare drawings showing just what amount of breakage of the M. C. B. coupler should cause its rejection. Messrs. Mackenzie, Adams, Bronner, Robson and Griffith were appointed as the committee.

At the meeting to be held on the fourth Wednesday in January, the topic discussed will be 60,000-lb. cars for merchandise. The annual banquet will take place at the same time.

Engineering Association of the Southwest.—Annual meeting of Nov. 13, Nashville Tenn.; 14 members and visitors present. The Secretary, Prof. O. H. Landreth, reported a total of 104 members of all classes enrolled, decreased by 1 death and 2 resignations to 101, as the present membership. The total receipts were $602, and the balance on hand is $577.07. Ten meetings were held during the year, 8 of them in Nashville, and 10 papers were read. The estimated revenue for the present year is $1,302. The officers elected for the ensuing year were as follows: President, John B. Atkinson; first vice-president, Wm. L. Dudley; second vice-president, Charles Hermany; secretary, O. H. Landreth, Nashville, Tenn.; treasurer, W. B. Ross. The next meeting will be held at Birmingham, Ala., on Dec. 12. The annual address of the retiring president, Mr. John MacLeod, of Louisville, Ky., was read by the secretary, in the unavoidable absence of Mr. MacLeod. The subject was the general development of engineering during the year. It was filled with valuable statistical information.

O. H. LANDRETH, Secretary.

Southern & Southwestern Railway Club.—At the meeting on Nov. 20 at Nashville, Tenn., the first subject discussed was, "Types of Heavy Locomotives Best Suited for Freight and Passenger Service." Mr. Ja. Meehan favored the American type locomotive up to 18 ins. diameter of cylinder. Above that size he would use ten-wheelers for passenger service and moguls for freight service. The consolidation engine was better than the mogul for freight service, however, but it should have at least 20-in. cylinders and weigh at least 127,000 lbs. In building ten-wheel locomotives he had found it best to make the middle driver instead of the front driver flangeless, as when the other plan was pursued the front driver dropped off the rail on sharp curves.

Mr. PULASKI LEEDS expressed similar views, and brought up the question of swing motion trucks for engines. He favored the rigid trucks except on two-wheel trucks.

A paper on "Joint Car Inspection" was then read by Mr. J. J. Casey, who favored having such inspection under control of the car departments, and having each road employ its own inspectors, the joint inspector acting as umpire. This view was favored by most of the members present.

The next meeting will be held at Atlanta, Ga., Jan 15. A paper will be presented by Pulaski Leeds on "Hanging Brakes to Car Bodies or to Trucks." Mr. A. G. Steinbrenner will discuss "Rigid and Swing Motion Trucks."

Engineers' Club of Philadelphia.—Nov. 15, President H. W. Spangler in the chair; 31 members and 7 visitors present. The Secretary presented, for Mr. R. Taylor Gleaves, a description of Continuous Rails for Railways, which are carried upon ordinary ties of wood or iron weighted down with a covering of earth, gravel or stone so that they cannot easily move. The spikes are not driven home by three-eighths of an inch, so that undulations may take place in the rail without disturbing either spikes or ties, and arrangements resembling turnouts are put in at fixed points, such as frogs, and at the foot of heavy grades, for the purpose of admitting of longitudinal motion.

The author explains how the rails are united so as to make them continuous. In the case he notes the rails were riveted together with fish plates. He says that while the riveting was in progress the expansion gave some trouble, but since it has been completed there has not been the slightest buckling or any perceptible pulling in on the curves. The ties are covered with red clay containing some loam, and, to prevent dust, part of the track was turfed and grass seed sown over the remainder, so that now he says "instead of a wrench the watchman pushes a mower, and the road bed looks like a pretty green lawn with two metal ribbons laid across it."

Speaking of the doubts which had been expressed as to the utility of this arrangement, the author says that it is a fact "that there is in Virginia a section of track laid with rails three miles long, that it has been in service since June, 1889, that it has not been surfaced or lined since put down, that the only expense of maintaining it has been the watchman, that engines weighing 104,000 lbs. are frequently run over it at a speed of 50 miles per hour, that it is simply ballasted with earth, and that he would take pleasure in showing it to any who care to investigate." HOWARD MURPHY, Secretary.

American Society of Civil Engineers.—The regular monthly meeting was held Dec. 3, President W. P. Shinn in the chair. The Secretary announced the death, on Nov. 25, of Mr. Thos. J. Whitman, of St. Louis, Past Vice-President of the Society. The President stated that the Committee on the Revision of the Constitution had handed to the Secretary amendments and a report; it was moved and carried that these should be printed and sent out to the Society in advance of the annual meeting. The Secretary read the names on the eight tickets for the nomination of officers for the ensuing year. The seven independent tickets are similar to that of the Nominating Committee (which was given in ENGINEERING NEWS Nov. 8) except in the names for a Vice-President and a Director in place of Mr. Bogart and Mr. Cooper, respectively, both of whom have declined the nominations, and for a Secretary and Treasurer. The nominations which are identical in all the eight tickets are as follows:

President, Octave Chanute.
Vice-President, Chas. Hermany,

Directors, Rudolph Hering, Clemens Herschel, Edward P. North, S. Whinery.

The nominations for the other four officers mentioned above are as follows:

	Vice-President.	Secretary.	Treasurer.	Director.
Nominating Committee.....	*J. Bogart.	J. C. Trautwine, Jr.	*Geo. S. Greene, Jr.	*T. Cooper.
New York Ticket.....	A. Fteley.	F. Collingwood.	J. Bogart.	C. B. Brush.
Albany "	*C. B. Brush.	*J. Bogart.	O. F. Nichols.	C. H. Myers.
Boston "	A. Fteley.	J. C. Trautwine, Jr.	*F. Collingwood.	C. B. Brush.
Philadelphia "	*C. B. Brush.	F. Collingwood.	J. Bogart.	C. H. Myers.
Pittsburg "	A. Fteley.	F. Collingwood.	*C. B. Brush.	A. P. Boller.
Cincinnati "	A. Fteley.	F. Collingwood.	W. H. White.	J. E. Childs.
St. Louis "	W. Kattè.	J. C. Trautwine, Jr.	A. P. Boller.	J. E. Childs.

* These nominations have been declined.

The business of the evening being concluded, Mr. Shinn, who had some committee business to attend to, called Mr. J. J. R. Croes, Past Vice-President, to the chair.

The paper of the evening was on "The Construction and Maintenance of Track," by Mr. J. A. Hall, M. Am. Soc. C. E. The paper was an interesting one, and was of a practical character, specially suitable for presentation, as it gave the author's own opinions and methods of practice, thus tending to draw out a general discussion. It is to be hoped that other papers of this practical and "live" character may be forthcoming at future meetings; they are really of more interest for reading and discussion at meetings than more elaborate and abstruse papers, though these latter have, of course, great value in the Society's transactions. We shall give some notes on this paper next week.

The following candidates were declared elected:

MEMBERS.

Geo. H. Kimball, Chf. Eng., L. S. & M. S. Ry., Cleveland, O.

H. M. Marshall, Miss. Levee Board, Vicksburg, Miss.

James Orange, Hong Kong, China.

Wm. A. Pike, Prof. of Engineering, Minneapolis, Minn.

F. M. Rood, Asst. Eng., N. Y. State Canals, Mechanicville, N. Y.

Wm. L. Scaife, Scaife Fdry. & Machine Co., Pittsburg, Pa.

Geo. C. Smith, Chf. Eng., Western Ry. of Uruguay, Montevideo.

R. Watkins, Sydney, Australia.

JUNIORS.

Wm. H. Chadbourn, Chf. Eng., Wilm., Chad. & Conway R. R., Chadbourn, N. C.

C. Davis, Dept. of Docks, New York City.

C. H. Deans, New York City.

A. C. Stites, Kansas City, Mo.

American Society of Civil Engineers.—The following circular has been issued: At a meeting of the undersigned members of the Society residing at Albany, N. Y., and vicinity, held at the office of the Railroad Commissioners at Albany, N. Y., on Friday evening Nov. 21, the following resolutions were adopted:

Whereas, The ticket for officers of the Society for the coming year submitted to us by the nominating committee contains the name of one candidate (for Secretary) whose eligibility is doubtful, and

Whereas, The ticket also contains the names of three other nominees who have declined to serve if elected to the offices for which they have been nominated, making it inadvisable to vote this ticket and highly desirable that another one be selected which shall be free from these objectionable features, and

Whereas, In our opinion the best interests of the Society demand the retention of Mr. John Bogart as Secretary, now, therefore, be it

RESOLVED, That the following ticket for officers of the Society is hereby put in nomination (ticket same as the official one, except as follows): For Vice Presidents, Charles B. Brush; Secretary, John Bogart; Treasurer, O. F. Nichols; Director, Charles H. Myers.

RESOLVED, That the Secretary forward a formal nomination, properly signed by at least five members, to the Board of Direction, and that he also mail a copy of these resolutions to each member of the Society.

E. Sweet, A. C. S. Wurtele, H. Andrews, A. J. Swift, G. P. Hilton, J. P. Kelly, J. A. Powers, G. I. Bailey, C. F. Stowell.

Of the 9 signers, 3 became members in the current year, 1 last year (1889) 2 in 1888 and 1 in 1887. The names of 5 members residing in the same locality, and averaging 10 years' standing, do not appear.

The following important circular has been sent out to all Members:

ELECTION OF OFFICERS IN THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

DEAR SIR;—It is probable that in the approaching election of officers in the American Society of Civil Engineers, there will be several nominees for some of the places on the ticket, and perhaps more than one complete ticket. In order to allow time for some harmony of action, after the nominations are sent out, you are respectfully requested to withhold your vote until some united action can be obtained. The local associations of members in several western cities will probably act in the selection of a ticket, if they can agree, of which action you will be informed in time to cast your vote.

The annual meeting occurs Jan. 21, 1891. The object of this communication is not to solicit your vote for any particular candidate, but only to inform you of the opportunity you will have of uniting your vote with others, if you should so desire, and will retain your vote until you are informed of this general action.

You are also reminded that you can at any time withdraw your vote and substitute another before the date of the annual meeting.

M. L. HOLMAN, ROB'T MOORE, ROB'T E. MCMATH, J. B. JOHNSON, BEN. L. CROSBY, GEO. BURNET, W. S. LINCOLN, E. D. MEIER, J. A. OCKERSON, N. W. EAYRS, CHAS. J. LEDLIE, S. B RUSSELL, O. B. WHEELER, D. W. WELLMAN.

St. Louis, Nov. 26, 1890.

Engineers' Club of St. Louis.—The club met Nov. 20 to discuss the problem of aerial navigation, its practicability, and the means whereby it might be attained, if attainable.

After transacting routine business Prof J. B. Johnson read a paper on the natural limitation of aerial navigation:

In this age of marvelous accomplishment, any statement of the necessary limitations to such achievements is apt to be received with surprise and incredulity, even by those best capable of judging of such possibilities. It is to be expected, therefore, that the assertion that there never can be a commercially successful solution of the aerial navigation problem will at once be received as a mark of dogmatic ignorance worthy of the Dark Ages. But in spite of the unfriendly atmosphere of the present time to the expression of such an opinion, and without forgetting the many notable instances of the failure of such predictions, it is the writer's firm belief, based on what he holds to be uncontrovertible natural facts and laws, that such is the case.

The first requisite to any scheme for navigating the air is the suspension of the vessel in the air, either by making its specific gravity the same as that of the atmosphere or by maintaining its elevation by mechanical means.

If the vessel floats by its own buoyancy it must be sustained by a gas lighter than air. If the lightest known gas, hydrogen, be used, then the total volume of air displacement will be 14 cu. ft. per lb. of total, dead and live, load. This buoyancy must be a variable quantity, also, both to overcome the natural variations in the atmospheric density, and to enable the vessel to return to earth and ascend again at pleasure. If no gas is ever discovered lighter than hydrogen, which is not probable, then a volume of 14 cu. ft. per lb. total load is the measure of the size of the ship. In case the vessel is only partly sustained by its buoyancy, and the remainder of the load is lifted and held in suspension by mechanical means, as by screw propellers on vertical axes, the power required is enormous, and it must be constantly exerted, without a moment's interruption, at the risk of the entire vessel falling instantly to the ground. It has been shown that to sustain one ton in the air by direct mechanical means, as by a horizontal propeller screw, would require the net expenditure of 60 HP. or 3 HP. per 100 lbs. of weight. It is, I believe, impossible that any motor will ever be made which, with its fuel for several hours' work, will weigh as little as 33 lbs. per HP., to say nothing of lifting any live load in addition.

Although experiments on atmospheric resistance are not numerous and complete enough to give the exact coefficients to use for any given shape and velocity, yet it is known in general that the coefficients which hold for water may be applied to air or to any fluid medium when due allowance is made for the difference in density. That is, the coefficient for air is appropriately equal to that for water divided by the ratio of the density of water to that of air.

The shape of a balloon offering the least resistance is that of a spindle tapering to a point at both ends. The length which gives the least atmospheric resistance is probably about five or six times the maximum diameter, and the volume may be taken as approximating that of a cylinder equal to three diameters in length.

The volume of such a cylinder is:

$$Vol. = 2.4\ D^3$$

Since one pound requires a volume of 14 cu. ft. to float it in the atmosphere, using hydrogen gas, to float one ton would require 28,000 cu. ft.

Or, if n is the total weight in tons, the diameter of the vessel of the above shape and proportions necessary to float the load will be found to be:

$$D = 22.8\ \sqrt{n}.$$

Without now going into a discussion of the coefficients of air resistance for such a vessel I will take that which was found from actual balloon experiments by Capt. RENARD, with the cigar-shaped balloon *La France*, which made seven trial trips in 1884-5, attaining to a speed of 14 miles per hour and five times returning to the starting point. He found the resistance to be:

$$R = 0.00032\ D^2\ V^2. \qquad (3)$$

Where R = resistance in pounds,
D = maximum diameter in feet,
V = velocity in feet per sec.

Since the immediate object here is the computation of the horse power required to propel the airship at given speeds, irrespective of the means which may be selected to do this, and since this is a function only of speed and resistance, we are now prepared to write an equation for the horse power. This is the resistance into the speed in feet per minute, divided by 33,000, or,

$$\text{Net HP.} = \frac{60\ R\ V}{33{,}000} = \frac{R\ V}{550} \qquad (4)$$

Substituting for R its value as given in Eq. (3) we have

$$\text{Net HP.} = \frac{.00032}{550}\ D^2\ V^3.$$

But Eq. (2) gives us d in terms of n the number of tons total load. Substituting this we have for the net HP.:

$$\text{Net HP.} = 0.0003\ n\ \tfrac{1}{3}\ V^3. \qquad (5)$$

But by any system of propulsion there must be at least 20% slip and 20% loss from internal resistances, making 40% of the total, hence the total horse power required to propel our air ship will be 40% more.

Now there is nothing in this equation which can be seriously in error, and for our present purpose it must be taken as sufficiently correct. The following table of gross horse power required for propelling air ships of the given gross tonnage at the given speeds has been computed by this formula:

Total horse power required for propelling spindle-shaped balloons:

Total Load in Tons.	Velocity in Miles per Hour				
	10	20	30	40	50
1.....	1.5	12	40	96	187
5.....	4.4	35	119	282	550
10.....	6.9	55	186	442	862

It is not probable, therefore, that a speed of more than 25 or 30 miles per hour will ever be attained with balloons. A balloon that can only move at a speed of 25 or 30 miles an hour could not hold itself up against a wind which near the surface registers only 5 or 6 miles per hour.

There remains one other class of aerial devices, called aeroplanes, or flying machines. They consist essentially of two large planes, arranged like the wings of a butterfly, but set at an angle of nearly 180°. If such a pair of planes are tilted slightly upward in front and pushed rapidly from behind, they will evidently float, and may be made to carry a considerable load, dependent on their area and speed. It has been found by Mr. Drzwiecki given by him in a paper before the International Congress of Aeronauts and Aviators, held in Paris during the exposition, that the most efficient angle at which to tilt the planes upward in front is 1° 50′, as at this angle the greatest sustaining power is obtained, with the least head resistance, or, what is the same thing, a given load is carried at a given speed with the least work.

A remarkable result of his investigations is that the resistance of such an aeroplane per unit load is a constant for all speeds, so that the work done in this case varies directly with tonnage and speed instead of with $n\ \frac{1}{3}\ V^3$, as was the case with the balloon. This is a much more hopeful prospect. It results from the fact that at greater speeds, for a given tonnage, the area may be reduced while the angle with the horizon remains the same. It is estimated that if a perfect piece of apparatus of this kind were once put in motion at 25 miles an hour, it would require but 6 HP. per ton to keep it moving horizontally through the air at that speed, or but 12 HP. per ton for a speed of 50 miles per hour. Even granting the truth of these figures, the difficulties that arise seems to be insurmountable. There seems to be no way to get started, or to stop, and the general stability of the apparatus to prevent some kind of a capsizing would seem to be impossible of attainment. No such apparatus, even as a toy, has ever yet been made of any significance, and here again I think we are warranted in indulging the most hopeless feelings in regard to ever attaining to anything like a commercial transport in the regions of thin air.

Western Railway Club.—At the meeting on Nov. 18 the first subject taken up was rigid vs. swing beam trucks, on which much discussion had already taken place at the last two meetings. A letter was read from Mr. G. W. Cushing in which reference was made to the necessity of the swing beam truck for use with M. C. B. couplers to relieve the strains on the drawbar and its stirrup and on the end timbers of the car and also avoid the liability to derailment when passing sharp curves with cars of various lengths coupled together.

Mr. J. W. Cloud placed additional emphasis on the need of a truck with a side motion on cars with the M. C. B

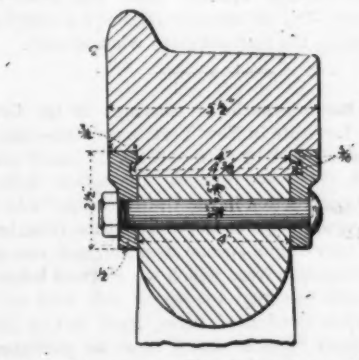
couplers. He then described experiments made by him some years ago to determine the relative resistance of rigid and swing beam trucks on a locomotive. The experiment were made with a dynamometer, and it was found that at average speeds the swing beam truck had a slightly greater resistance than the rigid truck. The swing motion seemed to allow a certain amount of play, which resulted in a lateral hammering against the rail. A large number of experiments confirmed the correctness of this result, and many railroads abandoned the swing beam truck under their locomotives because of this and because of the great wear of driving boxes and hubs with this type of truck.

A letter was read from Mr. D. J. Durrell, Mechanical Engineer of the Illinois Central R. R. The letter advocated swing beam trucks with long hangers, and the use of large wheels as thorough preventives of flange wear. Others had proposed to restrict the swing beam truck to cars below 40,000 lbs. capacity, but he would put it on cars as heavy as 63,000 lbs. capacity. He had noticed that cars having swing trucks, long hangers and large wheels did not crowd the rails in passing switch curves, where rigid trucks nearly turned the guard rail.

For length of hangers he recommended the formula:

$$\text{Length} = A\,B - \text{gauge of track.}$$

In this formula, $A\,B$ = distance from head of rail to point of intersection of center line of car body and line perpendicular to axis of bolster at the center (the car standing on a curve with outer rail elevated 3 ins.). The horizontal distance between centers of hangers should be at least 6 ins. more at the top than at the bottom. Such a truck, with fair track and wheels, he believed, would



Section of Locomotive Tire and Retaining Rings. Designed by the Midvale Steel Co.

give very little flange wear. He also recommended that the wheel diameter should be found by the proportion:

$$\text{diameter}: A\,B :: 2 : 2.75.$$

Concerning decrease of sharp flanges be said that in the first 6 months of the present year 632 wheels were removed from Illinois Central passenger equipment in the Chicago yards, and of this number but 11 were removed for sharp flanges. He had not been able to obtain the exact figures as to the saving in flange wear on Illinois Central freight cars by the use of the type of trucks above described, but considered it at least 65% to 75%. As to the cost of repairs, he found no difference between the two trucks, but considered that repairs to car bodies were heavier with rigid trucks. He agreed with other speakers that the binding of side bearings was a fruitful cause of flange wear. He recommended a maximum lateral swing of 1½ ins. each way from the center in truck bolsters. In conclusion he said that the removals of wheels for all causes on the Illinois Central during the past year averaged less than one for each passenger car, freight car and tender on the whole system.

In reply to questions, Mr. Durrell furnished the following statement of wheels removed at Chicago passenger station, Illinois Central R. R., during the first six months of 1890, with the causes of removal:

Crumbled tread	68	Soft chill	1
Flat from brakes	201	Chipped tread	3
Worn out	175	Chipped flange	1
Worn out and crumbled	2	Loose wheel	2
Sharp flange	11	Not stated	2
Total not fit for further service			466
Good — "cut or burnt journals"	7	Partly worn	159

Fit for further service, 166; total removals, 632.

Mr. Barr vigorously combated the position of Mr. Durrell that flange wear can be largely overcome by the use of any design of trucks, and gave as his opinion that four-fifths of all flange wear is caused either by difference in size of the wheels on the same axle or by difference in their wearing quality. One-fifth of the wear only is due to the truck. At the same time, he considered that the relative flange wear with the two classes of trucks would have much to do in determining their relative value.

Mr. D. L. Barnes spoke as follows with regard to swing motion trucks on cars with M. C. B. couplers:

While cars which vary in length, are passing curves, there is a difference in the lateral displacement of the ends of the couplers. To accommodate this, there is a space between the drawbar and the strap of about ¾ in., and there is also play at the ends of the journals, making a total of about 1¼ ins. Now, as it often happens that there is a difference of 4 ins. in the displacement, it seems to me that before the swing beam truck is discarded this point should be considered. I know of cases in which the backs of tenders and the fronts of baggage cars have been connected by automatic couplers, and the baggage car has lifted the tender off the track.

METHODS OF ATTACHING STEEL TIRES TO WHEEL CENTERS.

The discussion of the paper on this topic, presented at the previous meeting by Mr. Rhodes (ENG. NEWS, Nov. 8, p. 427) was then taken up. Mr. Rhodes exhibited sheets of drawings showing the amounts of wear which could be obtained from tires with different styles of fastening. Each tire is supposed to be 2½ ins. thick at the start. Assuming that flange wear will condemn the tire and that at the throat there must not be less than ¾ in. of metal, the following tread wear can be obtained with the different fastenings:

Fig. 1	1½ ins.
" 2	1⅝ "
" 3	1¾ "
" 4	1⅞ "
" 5	1⅞ "
" 6	1¾ "
" 7	1¾ "
" 8	1¾ "

This shows a difference of about ⅜ in between the maximum and minimum amounts of wear available. On a 42-in. tire this would be equal to about 70 lbs. of metal, which, at 2¾ cts. per lb., would cost $1.93; at 4 cts. would cost $2.80, and at 5 cts. would cost $3.50.

These figures, however, are only approximate, and this is, of course, only one of the things to be considered in weighing the merits of various forms of tire fasteners.

Mr. Rhodes also showed drawings of a tire and retaining rings, designed by the Midvale Steel Co. for an Eastern railway, and samples of broken tires which were secured, as shown in Fig. 6. In conclusion he repeated his opinion expressed at the last meeting that the best form of fastener is one which secures the tire to the center in a manner that will allow a slip of the tire without any shearing strain being brought on the fastener. In other words the fastener should be circumferential to the tire and not at right angles to it.

Mr. Harrison described the method of securing tires with hook-beaded bolts let in flush on the outside of the tire with a nut on the inside, which was used for 30 years on the Baltimore & Ohio. The wheel center is tapered 1½ ins. to the foot to take the tire, and seven or eight bolts are used. Recently the method has been abandoned and tires are now shrunk on. The principal object in changing was to facilitate renewals.

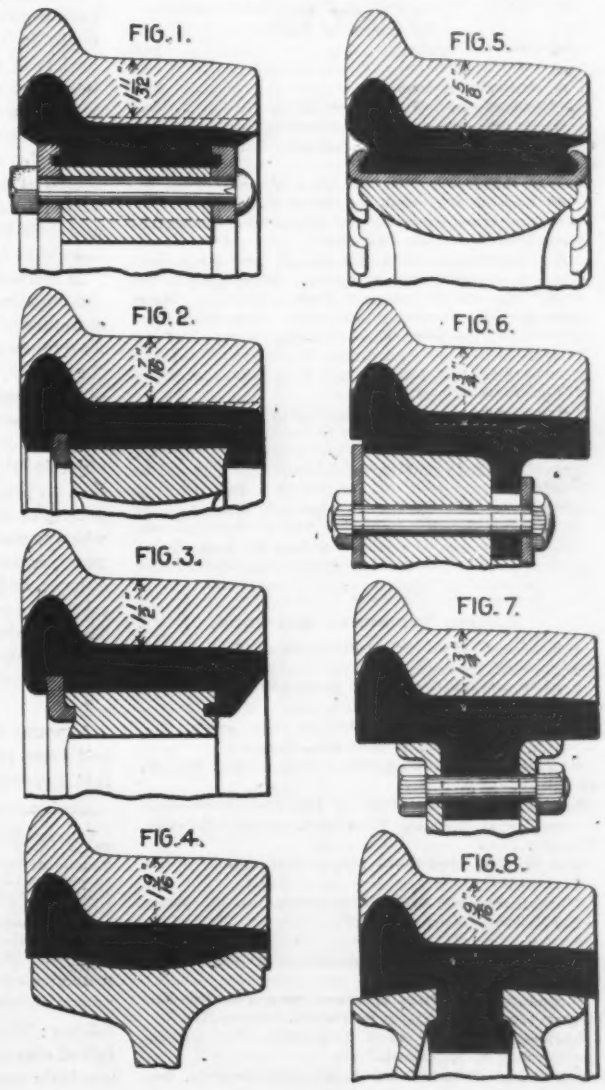
Mr. Barnes said he had seen a soft wheel center reduced nearly ⅛ in. in diameter at the wheel fit by too much shrinkage on the tire.

Mr. Forsyth doubted whether it was wise to use any of the ring fasteners shown in the drawing since the fastenings weaken the tire and materially reduce its life. Breakages often occur through the flange, which retaining rings would not hold. He suggested fastening by putting a tap bolt through the felloe, compensating for the weakening by adding to the steel tire the weight of the ring fastenings.

A paper on "Draft Rigging," by Mr. C. A. Schroyer, was then presented. The following is slightly condensed from the original:

Probably 50 per cent. of the cost of maintaining our freight car equipment to-day, not including wheels or axles, is in the draft rigging. It is well known that the tractive power of our road and switching engines has very greatly increased, and is probably double what it was 10 or 12 years ago, on many roads. More cars are being handled per train and the severity of the service in our switching yards is very greatly increased as a result of these conditions, while but little increase has been made in the power of the draft rigging to absorb the violent blows necessarily received. These blows, as you know, are taken on a line from 4 to 6 ins. below the sill line of the car, and in such a manner that the tendency is to break the sill downward over the bolsters, or upward over the cross center ties near the center of the car.

I believe a great mistake has been made in our freight car construction, whereby that part by which you intend to pull the car must receive these violent blows. I know of only three of the special devices on the market which make any effort to absorb the blow by cushioning, which to my mind is the vital point. Of these three, one aims to do its work by springs alone, whereby the same tensile resistance is offered that is had in the buffing resistance. This, to my mind, is a mistake, for the reason that in the use of a M. C. B. close coupler the rigging is too stiff and the engine cannot exert its tractive power as effectively as if greater elasticity was had in the tensile resistance, remembering that as a measure of safety we are limited in the forward movement of the bar. Another special device is aided in absorbing the blows by the use of friction plates, which are operative both in the backward and the forward movement of the bar. Another device aims at increasing the buffing resistance without any increase whatever in the tensile resistance. The majority, however, confine themselves to increasing the strength in the other parts of the draft construction, and the vital point, the absorbing of the blow, is entirely ignored by many except where they figure that the body of the car itself is capable of absorbing a greater or less amount. This capacity of the car itself to absorb blows depends largely on whether a continuous timber is used underneath the sill of the car and whether the stops are so framed that a very rigid bearing is had on these timbers, and also upon the casting of a lug on the top of the bar, which in its backward movement comes in contact with the end sill, with all of which conditions there is yet more or less destruction when the blow received is greater than the cushioning capacity of the springs used.



Sections of Locomotive Tires with different fastenings. Showing metal available for wear before tire is condemned.

(Thickness of all tires when new, 2 1-2 ins. Area in black shows tire worn to 1 in. thick at center of tread and turned down for final run. Dimension in center of tread shows thickness of metal available for service before tire is condemned at 3-4 in. thickness.)

It is the universal practice in our country to use a coil steel spring in the absorbing of these blows, and we are limited in the strength of any coil spring which can be used, as follows: In the length of the spring, by the need of preventing an increase in the movement; in the diameter of the spring, by the size of the opening and the diameter of the bar, and in the pitch of the spring by the torsional strains on the bar. Hence, in a spring 6 × 8 ins. in size from 20,000 to 22,000 lbs., and in a spring 6 × 7 ins. from 18,000 to 20,000 lbs. is the maximum strength from which good service can be expected, when the springs are made of the best crucible steel.

The author then described tests of the buffing resistance of springs, from which he concluded that the power to absorb the blow received should be confined to some elastic construction in the draft rigging, rather than to any portion of the construction which is intended to be rigid with the car body.

At the next meeting, Dec. 16, Mr. Schroyer's paper will be discussed and a paper on "Air Brakes and Vertical Plane Couplers in Service for Freight and Passenger Trains" will be presented by D. L. Barnes.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.

Vol. XXIV. Saturday, December 6, 1890

D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST.....BUSINESS MANAGER

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COMING TECHNICAL MEETINGS.

Engineers' Club of Philadelphia.—Next meeting, Dec. 6. Secy., Howard Murphy, 1122 Girard St.

Civil Engineers' Club of Cleveland.—Next meeting, Dec. 9. Secy., A. H. Porter, 50 Euclid Ave.

Western Society of Engineers.—Next meeting, Dec. 9. Secy., J. W. Weston, 230 La Salle St., Chicago.

New England Railroad Club.—Next meeting, Dec. 10. Secy., F. M. Curtis.

Engineering Association of the Southwest.—Next meeting, Dec. 11. Secy., Olin H. Landreth, Vanderbilt University, Nashville, Tenn.

New York Railway Club.—Next meeting, Dec. 18. Rooms, 113 Liberty St.

Western Railway Club.—Next meeting, Dec. 16. Rooms, Phenix Building, Chicago. Secy., W. D. Crosman, 816 Rookery, Bldg.

Engineers' Club of Cincinnati.—Next meeting, Dec. 16. Secy., J. F. Wilson.

Engineers' Society of Western Pennsylvania.—Next meeting, Dec. 16. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers. Next meeting, Dec. 17. Secy., S. E. Tinkham.

Engineers' Club of St. Louis.—Next meeting, Dec. 17. Secy., W. H. Bryan, 30 South 7th St.

Denver Society of Civil Engineers.—Next meeting, Dec. 23. Secy., Geo. H. Angell.

Civil Engineers' Society of St. Paul.—Next meeting, Jan. 5. Secy., G. L. Wilson.

Technical Society of the Pacific Coast.—Next meeting Jan. 9. Secy., O. von Geldern, 408 California St., San Francisco.

American Society of Civil Engineers.—Next meeting, Dec. 17. Secy., John Bogart, 127 E. 23d St., New York.

Civil Engineers' Association of Kansas.—Next meeting, Jan. 14. Secy., J. C. Herring, Wichita, Kan.

OUR readers will recall that in our issue of Aug. 9 last we illustrated a quite novel form of locomotive feed water purifier, of which we then expressed a high opinion. In another column we give the latest results of experience with this device, the Barnes Feed Water Purifier, and we cannot but think the results so significant and promising as to make it proper to call this special attention to them. While it is yet too early to express a positive and final opinion upon the merits of the device, enough is already proved for it to make it worth careful attention, and we shall be somewhat surprised if it does not result in large economies in districts where the available feed water is bad.

IN another column we publish an extended opinion on the eligibility of Mr. JOHN C. TRAUTWINE, JR., as a candidate for Secretary of the Am. Soc. C. E., received since our last issue. This opinion only confirms those already published, and coming as the carefully digested verdict of an eminent legal firm, it removes all question of doubt. Mr. TRAUTWINE can be legally elected if the majority of the membership of the Society believe, as we do, that he is eminently qualified to fill the office and to work for the good and advancement of the Society's interests. The coming election promises to be the most lively event of that character in the history of the Society, especially in the variety of tickets presented to the membership for their choice. It is a healthy sign of an awakening interest in the future management; and whatever the personal result may be, the radical departure from the formal, unopposed tickets so long presented at these annual meetings must redound in some practical good and the infusion of new blood and considerably more energy and purpose into the executive body of the Society.

It is a delicate matter to discuss the personal qualifications of the several candidates for the secretaryship. But, at the same time, this is the really important office to be balloted for; and upon the energy, executive ability and business capacity of the incumbent really depends the growth and general usefulness of the Society. The present issue is not one of men, for the men are all most unobjectionable; it is the broader question of what is best for promoting the advance of the American Society of Civil Engineers, and truly making it what its name implies, a national society of engineers, commanding the respect of all classes of citizens, and a power and authority in all matters pertaining to engineering throughout the land. This is undoubtedly the wish of the entire present membership and with the realization of this wish the next secretary will have much to do.

JUDGING from the history of kindred societies and from past experience, the qualifications for this important office may be briefly outlined as follows: The secretary should be a young man, full of energy and work; not so young as to have too little acquaintance with the world and its ways, but young enough to devote a goodly span of years to promoting the growth of the Society, should he prove fitted for that task and show his fitness by tangible results. Mr. JAMES FORREST, whose good work as Secretary of the Institution of Civil Engineers is known throughout the world of engineering, became the active Secretary of that body 34 years ago, when he was still a very young man. He is only an Associate of the Institution now; but his years of faithful service have undoubtedly been the chief factor in the phenomenal growth of the chief engineering association in the world, as elsewhere outlined in this issue. The secretary should be methodical, so that he can care for the property of the Society and direct his subordinates. He should have a broad acquaintance with engineering literature and be prepared to edit the contribution of engineers, sometimes crudely presented. The publication of the transactions of the Society is the chief item of annual expenditure. Hence the secretary should have some experience in the intricacies of publication, for upon the extent of this knowledge depends economy or waste in this item, and the presentation of the matter in the best and most convenient form. The secretary should be courteous to all members alike, so far as is consistent with his utmost usefulness to the entire membership. And, above all else, he should allow no personal temptation of outside service or emolument to divert him from the single service of the Society. All of his active time, all of his mental endowments, his past experience and what he can gather from persistent and careful study, should be devoted solely and constantly to advancing the interests of the Society as a national body of engineers. These interests are so varied and so wide that, if they are to be promoted effectively they demand all the time and energy of an active man.

Our interest in the present issue is that of every member of the American Society of Civil Engineers; and owing to personal relations with all the candidates, it is with considerable regret that we find ourselves forced, by the opposition to the ticket of the nominating committee, to make a choice. But basing our decision solely upon what we consider as promising the most and the best work for the whole Society, and as most nearly meeting the requirements outlined above, we again express our opinion that Mr. JOHN C. TRAUTWINE, Jr., is not only eligible for election but will make the best secretary when elected.

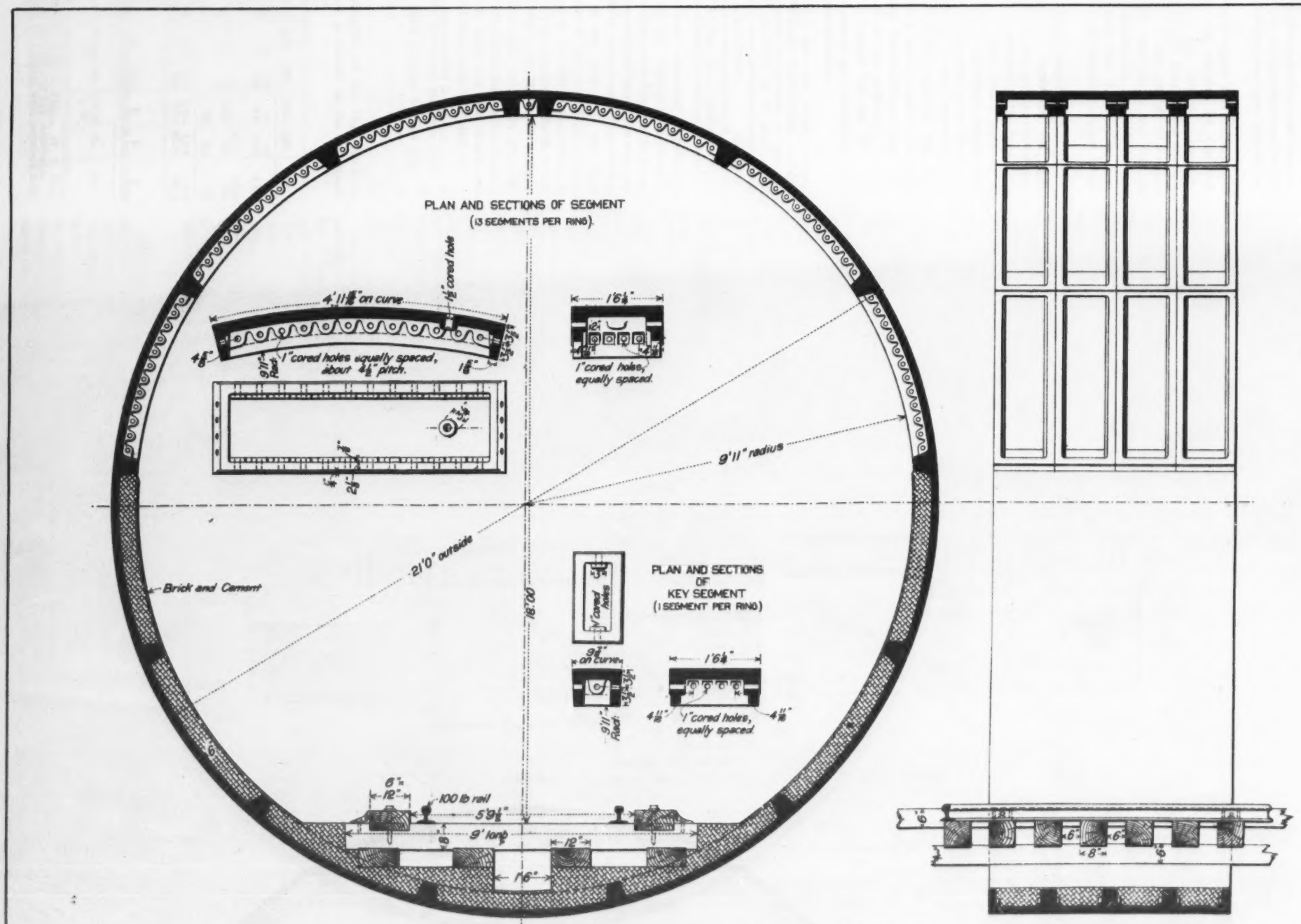
AT the late international meetings of the Iron and Steel Institute in New York, a very interesting and valuable paper by Messrs. GEO. H. CLAPP and ALFRED E. HUNT was read on "Inspection of Materials of Construction in the United States," which it was impossible for us to publish at the time, but which is deserving of special mention, and one or two notable points from which we abstract below. The difficulty was, that a paper of this kind cannot be much condensed, being itself but an abstract of many facts, so that it must be published in full or not at all; but the following curious table of the changes which have taken place in a single prominent engineer's specifications for structural steel within the last decade, will be examined with interest and profit by every one as illustrating tendencies:

	1879.	1881.	1882.	1885.	1887.	1888.
TENSION MEMBERS.						
Elastic limit	50,000	40@45,000	40,000	40,000	40,000	38,000
Tensile strength	80,000	70@80,000	70,000	70,000	67@75,000	63@70,000
Elongation in 8 ins.	12%	18%	18%	18%	20%	22%
Reduction area	20%	30%	45%	42%	42%	45%
Kind of steel	O. H.	O. H. or B.	O. H.	Not spec.	O. H. or B.	O. H. or B.
COMPRESSION MEMBERS:						
Elastic limit	Same	50@55,000	50,000	50,000	Same as tension members.	
Tensile strength	as	80@90,000	80,000	80,000		
Elongation in 8 ins.	ten-	12%	15%	15%	"	
Reduction area	sion.	20%	35%	35%	"	

Among other contents of general interest which may be briefly noted are some new evidence that frost does have a decided effect upon the resistance of metal to impact or other sudden strain, and a striking statement of the comparative unreliability of Bessemer steel for structural purposes. The existence of this disadvantage is sometimes disputed, and it is plainly one which may in time be overcome by further perfection of processes, but the curious example cited of the unprovoked rupture of a 12-in. beam in unloading, the beam being wholly without any sign of defect either before or after the fracture, is alone enough to prove that the prevalent feeling is not without justification. The details given in the body of the paper we can only advise each interested reader to study for himself. Rail inspection is not referred to at all.

The Institution of Civil Engineers.

The fiftieth anniversary of the foundation of this great Institution, the original of all the engineering societies of the world and now numbering nearly 6,000 members of all classes, was celebrated by its Council in the session of 1885–86 by a full his-

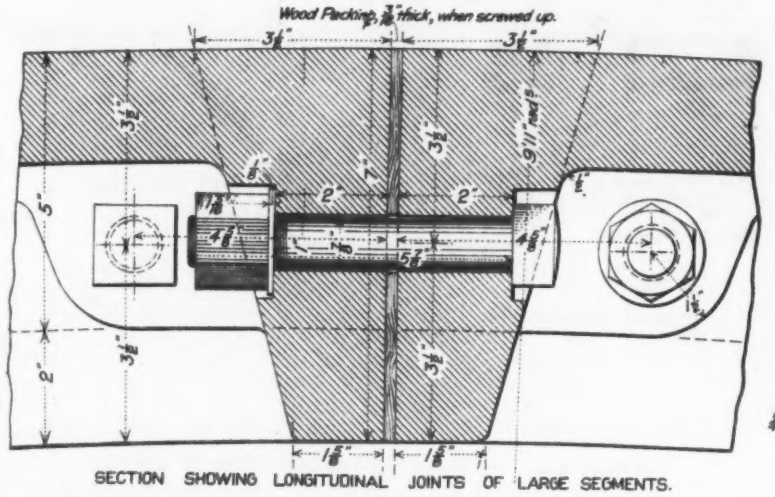


TRANSVERSE SECTION AND PART LONGITUDINAL SECTION OF COMPLETED TUNNEL, SHOWING ARRANGEMENT OF TRACK.

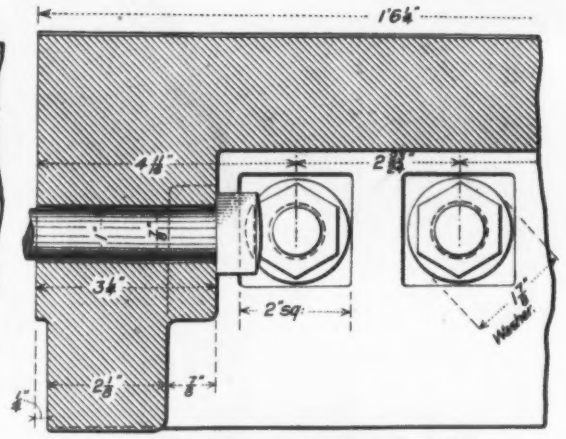
Wood Packing, ¾" thick, when screwed up.

1'6¼"

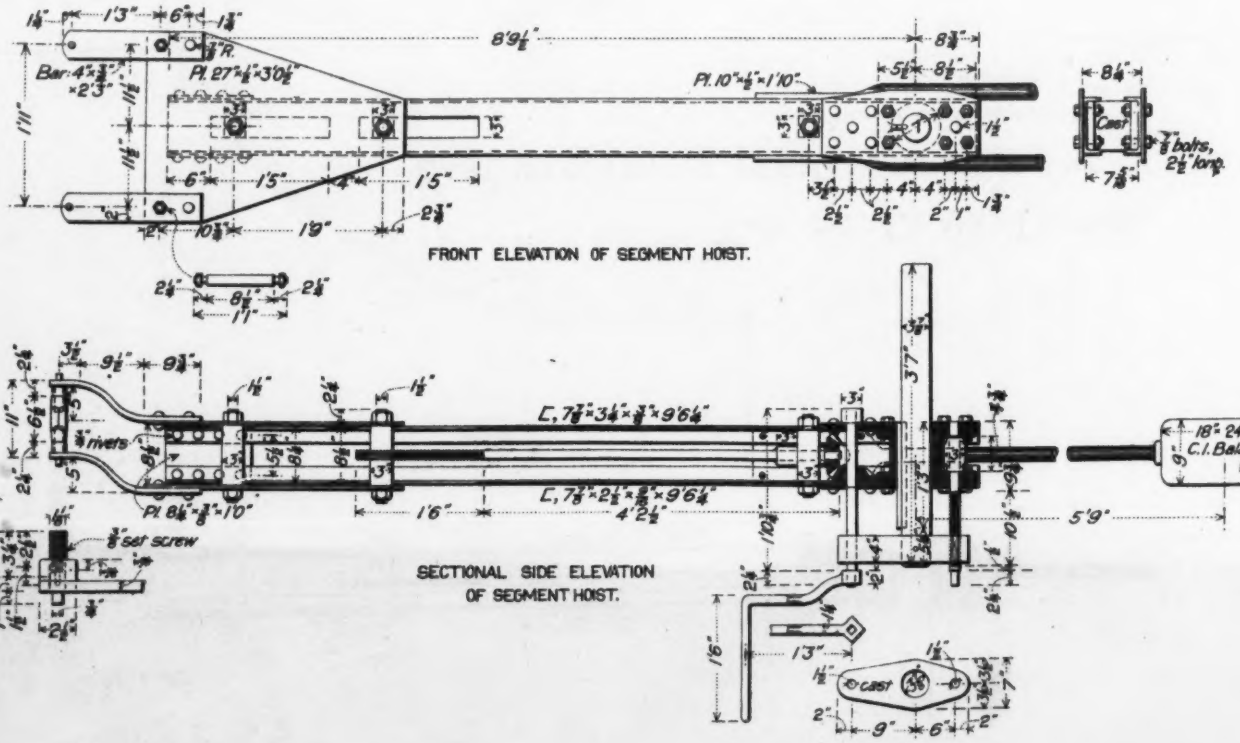
TRANSVERSE SECTION AND PART LONGITUDINAL SECTION OF COMPLETED TUNNEL, SHOWING ARRANGEMENT OF TRACK.



SECTION SHOWING LONGITUDINAL JOINTS OF LARGE SEGMENTS.

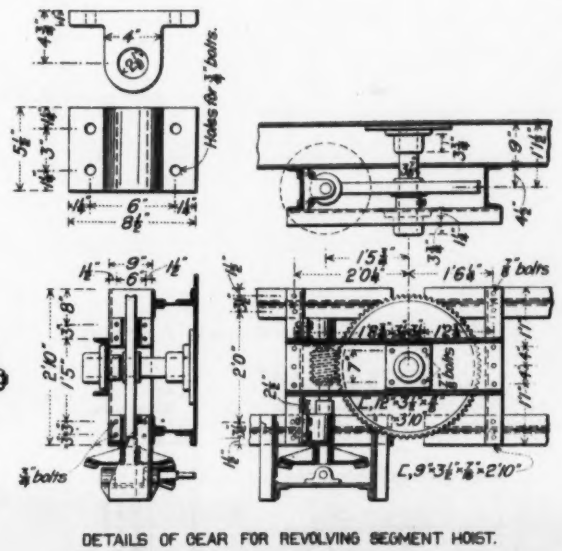


SECTION THROUGH CIRCUMFERENTIAL FLANGE.



FRONT ELEVATION OF SEGMENT HOIST.

SECTIONAL SIDE ELEVATION OF SEGMENT HOIST.



DETAILS OF GEAR FOR REVOLVING SEGMENT HOIST.

The St. Clair Tunnel.

THE ST. CLAIR TUNNEL.

CAST IRON LINING, PERMANENT WAY AND SEGMENT HOIST.

JOSEPH HOBSON, CHIEF ENGINEER.

CHAS. HART & SONS, LITH., 24 VESEY ST., N.Y.

torical sketch of its organization and policy. As its contents are of much interest to all engineers, and as there has lately been reported a revised constitution for the American Society of Civil Engineers, which will shortly be issued for ballot (but as to the provisions of which we know nothing) an abstract of the successive steps and changes by which the greatest of engineering societies has reached its present position may have special interest at this time.

A Society of Engineers which still exists, as we are surprised to learn, was founded by SMEATON in 1771. It still, says the Council, "includes many of the most eminent members of the profession, but it is rather of the nature of a social club than of a scientific association, and has no connection with this institution. It was of too exclusive a nature to meet the wants of so large and mixed a body as soon became engaged in engineering."

When this now almost forgotten mutual admiration society was 47 years old (the Am. Soc. C. E. is now 38 years old), and doubtless considered itself firmly established as *the* Society, a speck no bigger than a man's hand arose on its horizon, in a movement by six bright young men* to found a society of broader and more liberal policy, which they christened THE INSTITUTION OF CIVIL ENGINEERS. Their first meeting was Jan. 2, 1818. It continued to slowly gather members for two years, all being inconspicuous men, however, as is apparent from the following humble and quaint resolution, passed Jan. 23, 1890, with which the real existence of the Institution, as an institution, may be said to begin :

Resolved, That in order to give effect to the principles of the Institution, and to render its advantages more general both to the members and the country at large, it is expedient to extend its provisions by the election of a President whose extensive practice as a civil engineer has gained him the first-rate celebrity; * * * and that a respectful communication be made to THOMAS TELFORD, Esq., civil engineer, *requesting him to patronize this Institution by taking upon himself the office of President.*

Mr. TELFORD graciously consented to patronize the embryo institution by "taking upon himself" that office, though he had never heard of it before this humble invitation reached him. He was, perhaps, disgusted with the narrowness of the Society of Engineers, and at any rate, took and most worthily filled the office of president thus tendered from 1820 until his death in 1834, bequeathing to it at his death the Telford premium fund, which now amounts to $43,000; a gift the more remarkable because it was not until two years after his death that Vol. I. of the Institution's great series of transactions (Vol. CII. being the last issued) was published. The Institution then consisted of :

Members (practicing engineers living in London)	45
Corresponding Members (practicing engineers living out of London)	91
Associates (persons in allied pursuits, but not practicing engineers)	88
Honorary members	14
Total	238

The subsequent progress of the Institution in members and income is shown in the subjoined table :

	1836	1846.	1856.	1866.	1876.	1886.	1890.
Hon. members	14	35	26	20	14	20	19
Members	45	207	289	541	864	1,542	1,684
Cor. members	91	.....	.....	.....	.....	.....	.....
Asso. members	.....	.....	.....	.....	.....	2,111	2,768
Associates	88	314	466	771	1,582	501	432
Graduates	.....	44	16	7	.....	.....	.....
Students	.....	.....	.....	.....	384	926	969
Total	238	600	797	1,339	2,844	5,100	5,872
Av. inc. per yr	.....	36.2	19.7	54.2	150.5	225.6	193.0
Total income from all sources, taking £1 = $5	$ 3,565	$ 8,855	$ 10,000	$ 33,585	$ 55,825	$ 90,725	$ 112,200
Council, Prest. Vice-Prests. Councillors	1-4-7 = 12	1-4-10 = 15†	1-4-12 = 17†	do.	1-4-15 = 20	do.	do.

* Messrs. WM. MAUDSLAY, JOSHUA FIELD, H. R. PALMER, JAS. JONES, CHAS. COLLINGE and JAS. ASHWELL.
†Two of these Members of Council were required to be Associates.

The successive changes in and features of administration of the Institution may be summarized as follows:

GRADES OF MEMBERSHIP.

The Institution started with Members and Associates in nearly equal numbers, as shown, all being equal sharers in the privileges of membership. In 1838 the division between Members and Corresponding Members was dropped, and a new grade for younger men, called "Graduates," added, this grade also enjoying full corporate privileges. The graduate grade never became very large, but the incongruity of granting the ballot to these young men was felt, and in 1846 their corporate privileges were taken away, and the grade allowed to slowly die out. At the same time the qualifications for Members were raised, and those for Associates broadened, with the foolish idea of using the same grade for young engineers and distinguished practitioners of allied professions.

This system continued for 20 years, until 1866, Members and Associates alike having corporate privileges. Then the present grade of Students was created, a grade in which young men enter and remain at the pleasure of the Council until a certain age (26) only, when they must either be promoted or drop out. They have special meetings of their own (but with right to attend the other meetings) and no right to vote or hold office. The grade is universally felt to be an important and successful one, as certainly it is in numbers. Very recently the educational requirements for the admission of Students have been much raised, amounting practically to requiring graduation at a technical school. Consequently, the rate of increase of the grade has been slightly checked. Students pay $10 per year with no entrance fee.

In 1878 the mixed grades of Associate was split in two, into "Associates entitled to the privileges of corporate members," now generally called Associate Members, being the younger and less prominent practicing engineers, and Associates proper, men of allied professions not in active practice as engineers, the last not being entitled to vote or serve as members of the Council, although they can and do serve as Secretary. Four years' discussion preceded this change. Of late there has been a tendency to restrict admission to the Associate grade to men of real eminence, so that the grade does not increase fast. The eminent Secretary of the Institution is of this grade, and has no vote. To this grade only are military engineers eligible, the Institution jealously guarding the true meaning of the term *civil* engineer, so that it shall, on the one hand, include only men who are engaged in the peaceful arts of engineering, and on the other hand, *all* those engaged in any form of civil practice, including mechanical, mining and electrical engineers, who constitute, in fact, the larger half of the Institution. In both of these respects the practice of the American Society of Civil Engineers is less consistent.

Members and Associates have from the begininng paid $51.20 entrance fee, and yearly dues of $20.48 for Members and $15.36 for Associates, if resident ; and $15.36 and $12.75 respectively, if non-resident. Admission to the highest grade, Member, is very jealously scrutinized and restricted to engineers of some considerable prominence. Consequently the lower grade of Associate Member, for which there is no corresponding grade in the Am. Soc. C. E., is much the largest in the society ; almost as large as all the other three grades together.

OFFICERS.

After TELFORD's death, in 1834, a new president held office for 10 years, but in 1845 the custom of only two years' term was started, and in 1880 this was reduced to a one-year term, although the "by-laws" (or constitution) still permit a president to be renominated once. The idea of the frequent change is, of course, to gratify the ambition of as many men as possible, but it is somewhat to the disadvantage of the Society, and in a small body like the Am. Soc. C. E. exhausts the available material very rapidly. The nomination for President of the Institution must be each year (or every second year if he holds over) the Senior Vice-President, all the contest between individuals being for admission to the Council.

For that the Council makes 24 nominations yearly, only 15 of whom are elected, the members expressing choice by erasing names. The Council also nominates (and hence practically elects), the four vice-presidents. There is as yet no letter ballot, only members attending in person having the right to vote. In 1873 and again in 1883 an effort was made to establish one, but it was deemed "inconsistent with the provisions of the charter." As the charter is from George IV., and can be (in fact, has been in another respect), changed or broadened for the asking, this is probably a mere excuse, like some other constitutional quibbles, the real difficulty being that the few who are enjoying disproportionate power think it for the best good of all that they should continue to do so—a very common and very human weakness.

The Councilors are nearly all Londoners, by custom, only 3 out of the 25 living outside of London at the present time, and they not far out. The changes are very few; only 83 different men were elected to office in the whole half-century from 1836 to 1886. The average term of office was therefore over 11 years.

THE SECRETARYSHIP.

The course of the Institution in regard to this important office is full of instruction. It was filled in 1837 by "Mr. THOMAS WEBSTER, M. A., a well-known barrister," who continued in office till 1839. Then, the Institution numbering some 400 only, "it appeared to the Council that the increasing business was such as to require the whole and undivided time and attention of a properly qualified gentleman to fill this place as a paid officer, and it was taken on this condition by Mr. CHARLES MANBY," a Member of the Institution.

Mr. MANBY continued to fill the office well for 17 years, when with truly admirable delicacy and right feeling—but we will quote the words of the Council:

"In June, 1856, Mr. MANBY, who had held the post of Secretary for 17 years, tendered his resignation, having accepted a professional engagement which prevented his devoting the necessary attention to the work of the office. He agreed, however, to continue to act gratuitously, and subsequently was appointed Honorary Secretary, a position he held till his death on July 31, 1884."

This was the origin of that curious office of Honorary Secretary, which has now become a mere empty dignity, and as such seemed somewhat of a puzzle. It was expressly created to honor the faithful and unselfish service of a single official, who, when he could no longer render this full measure of service because of the distractions of an outside office, insisted upon resigning.

Then, in 1856, began the brilliant career of Mr. JAMES FORREST, Assoc. Inst. C. E., in the office of Secretary. Under him, and very largely as the result of his faithful service and excellent judgment, the Institution began to rapidly advance both in quantity and quality of membership, until in the 34 years of his service it has grown from 800 to nearly 6,000 members of all classes. He was at first appointed Assistant Secretary, an office which, we have heard it rumored, it is proposed to create within the Am. Soc. C. E.; but the palpable injustice of allowing one man to have the name and another man to do the work was too apparent, and in 1860 Mr. FORREST was made full Secretary. Since that date there has been no change, and it is safe to say there never will be, so long as Mr. FORREST is able to discharge any of the duties of the office.

The Treasurer of the Institution is merely "a banker in the Metropolis." The Secretary is in

law, as he is in fact in all such societies, the working treasurer as well.

THE LIBRARY.

The library of the Institution is very carefully looked after, and has became very large. The present accessions are at the rate of about 800 volumes annually. "It is gratifying to find that it is largely attended, a sure proof that the efforts made to keep the collection abreast of engineering progress are fairly successful." The present annual expenditure on it is about $2,900, divided as follows:

Purchase of books	$1,830
Periodicals (chiefly given in exchange)	310
Binding	760
	$2,900

The American Society of Civil Engineers nominally spends $700 to $800 in its library; but this expenditure is really almost wholly on salary account. Only a few of the engineering journals are bound yearly, and practically no books are ever bought. The Institution's library account is wholly for accessions to its shelves, the salary charges for attendance to it being charged under the head of salaries.

As for the past of the Institution's library, we cannot do better than quote from the Council's history.

The library is a feature of which the members have just reason to be proud. Originating with a present of books from TELFORD, on his assuming the Presidency, it contained in 1851, when a catalogue was first published, 3,000 volumes and 1,500 tracts. Fifteen years later (1866) there were 5,500 volumes and 3,200 tracts. In 1873 it was ascertained by actual enumeration that the number of volumes was 10,143, including 320 volumes of tracts, and at the present time (1886) it consists of about 21,000 volumes, occupying 2,238 lin. ft. of shelves. It may be said to include most English works and a great many foreign ones on engineering and allied subjects. Indeed, *it has been the aim of the management to take care that any treatise an engineer may reasonably want for his professional work shall be found in the institution.*

BUILDING.

The Institution took a small house in 1834, but moved to its present location in Great George St. in 1838, building on to the house rented a meeting room 30 ft. square. In 1846 it spent $21,500 in enlarging its building, raising the money by a special charge of $35.84 on each Member, and $20.48 on each Associate. In 1868 it leased adjoining premises for 99 years, and constructed the building substantially as it now is, with a meeting room 60×40, at a cost of $85,000 to $90,000, inclusive of furniture, the money being obtained from its invested sources. The ground rent charges were $3,300 per year, which have been lately extinguished by purchase of the freehold. It should be said that all admission fees, as well as all life compositions, are religiously credited to capital account, and not to current resources.

PAPERS AND PUBLICATIONS.

Three quarto volumes of publications were issued between 1836 and 1844, when Vol. I. of the present long series of octavo volumes was issued. In 1870 the practice of issuing two volumes yearly was begun, and in 1873 the issuing of four volumes yearly. At this date also the "Abstracts of Papers in Foreign Transactions and Periodicals" was begun, which is a much appreciated feature of the Institution publications. These yearly volumes now aggregate over 2,000 pages yearly, very handsomely printed, and accompanied by finely engraved plates, all in a uniform style, which is far ahead of anything done in this country in the same way.

The Institution does not by any means print all the papers it receives, but from the large number sent in, ranging from 50 to 100, the Council selects a dozen or so to be read and discussed at the meetings, and numerous others to be printed without discussion. Thus there is a chance to select only papers likely to provoke discussion for presentation at the weekly meetings which are held during the "session," from November to May.

INCOME AND EXPENSES.

For the year ending March 31, 1890, this may be abstracted as follows, taking £1 = $5:

RECEIPTS.

Current dues	$73,180
Income from investments	13,320
Library fund and miscellaneous	1,890
Total available for current expenses	$88,390
Additions to capital. Entrance fees	15,315
Life compositions	3,660
Total receipts, *ex* premium funds and bequests	$107,365

EXPENSES.

For house and meetings	$10,765
Salaries	11,875
Clerks, messengers, housekeeper	4,695
Library, for books and binding	2,905
Publication of "Proceedings,"	32,870
List of members, etc	1,075
Postage, telegrams, parcels	1,500
Stationery and printing	3,310
Other miscellaneous expenses	4,455
Total current expenses	$73,480
Balance to capital account, about	$33,885
March 31, 1886, the total invested funds were	358,214
" " 1890, " " " " " "	520,930
Gain in four years	$162,716

CORRESPONDENCE.

The Stability of Lighthouses.

WASHINGTON, D. C., Nov. 19, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: As the stability of a lighthouse is certainly of the gravest importance and the very thing that it is desired to accomplish, by means of calculation as well as by application of experience and shape of design, I feel it my

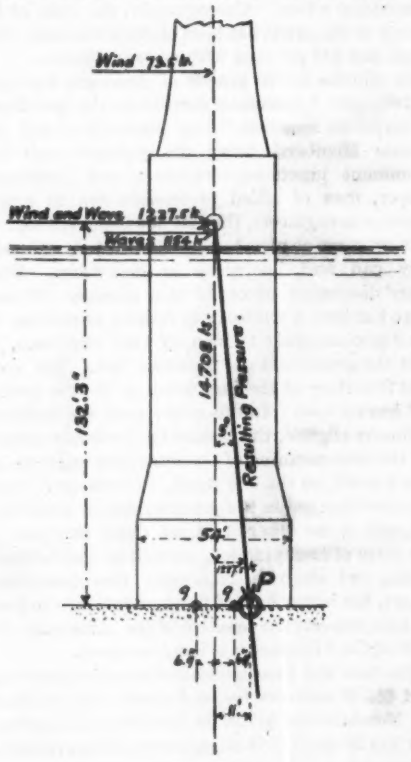


Fig. 1.

duty to call attention to some facts which seem to have been overlooked by Mr. JULIUS E. RETTIG in his article on "Wave Pressure on Exposed Structures" in your journal of Nov. 15, following your article of same title of Sept. 16, 1890.

Mr. RETTIG concludes his article with an investigation of the stability of the adopted Anderson & Barr design for Diamond Shoals Lighthouse under *four* assumptions, which shall also form the basis of the following investigation. Under the head of "Results," Mr. RETTIG figures out a stability of the structure of 2.5. But, from the start it is self-evident that the fulcrum to which the moment of stability has been referred *cannot* be taken in the outermost edge of the base of the tower, or 27 ft. from the center, as Mr. RETTIG has done.

The position of the fulcrum of stability is limited by the following laws of experience and theory, which we will quote essentially from Rankine's "Applied Mechanics," pages 226, section 205, and following:

In towers and chimneys (or similar structures) exposed to the pressure of the wind (and waves), it is obvious that in order that the stability may be secure, no bedjoint ought to tend to open at its windward edge; that is to say, there ought to be some pressure at *every* point of each bed joint, except the extreme windward edge, where the intensity may diminish to nothing, which would indicate that tension has just been avoided at that point. The intensity of pressure at the leeward edge under this condition would be exactly double the mean intensity, assuming always that the pressure is uniformly varying. These just stated pressures involve that the deviation of

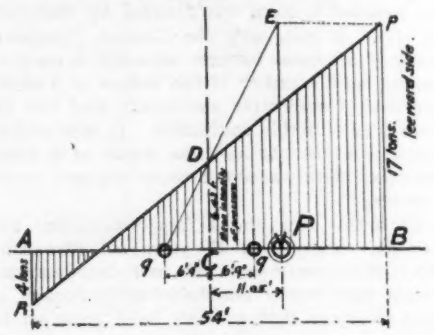


Fig. 2,

the center of pressure, or (what amounts to the same thing) the permissible point of rotation for stability from the centre of the figure, shall not "exceed" a certain fraction of the diameter of the joint, which RANKINE calls "q" and which is dependent wholly on the figure of the joint.*

In other words, if the center of pressure or fulcrum of stability coincides with the limit of the "core" or "kernel" of the cross section of the figure, such position will be the limiting one for showing that no tension would exist in the surface of the joint, but that the joint is just on the verge of opening on the windward side.

Proceeding now to investigate the stability of the Diamond Shoals Lighthouse, and assuming that the forces acting on the structure, and the other conditions as stated by Mr. RETTIG, to be correct, the fundamental principles of stability require that the following three conditions should be complied with in spirit and in the letter:

I. *To insure stability of position*, the center of pressure must not deviate from the center of the figure of any joint by more than a certain fraction q of the diameter of the joint, measured in the direction of deviation. For a circle, q is equal to ⅛ of the diameter, and for the case in question amounts to ⅛ × 54 ft. = 6 ft. 9 ins.

II. *To insure stability of friction*, the direction of the resultant pressure at a joint must not make an angle greater than the angle of repose with a normal to that joint drawn through the center of pressure. For wet sand the angle of repose is 24°.

III. *To insure stability of strength*, the pressure per square foot at the most pressed edge, the extreme leeward side in any joint of the foundation (which we are considering only in these remarks), must not exceed the permissible load (compression) per square foot, 9 tons on sand, as assumed by Mr. RETTIG.

In reference to the accompanying diagram, Fig. 1, which has been partly extracted from Mr. RETTIG's article, we have as to the first condition a deviation of the center of pressure P from the center of the lighthouse of 11.05 ft. as a calculation will show. As the permissible deviation is only 6.75 ft. the stability of the lighthouse is

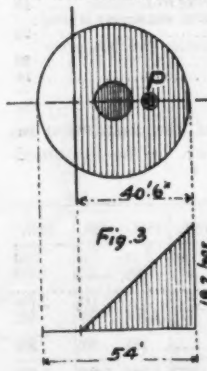


Fig. 3.

$$\frac{6.75}{11.05}, \text{ equal to } 0.6,$$

or in other words there is *no* stability of position under the assumed forces and shape of the structure; it would yield to wind and waves.

As to the second condition, we find the obliquity of the resultant pressure to be about 50°, so that a horizontal sliding of the tower on the sand would not take place.

As to the third condition, we find by stress diagram, Fig. 2,† that on the leeward side the pressure on the sand foundation amounts to 17 tons, and is so little as this only if the sand is able to take up a tension of 4 tons per sq. ft.

*In German this fraction "q" would be called "Die halbe Kernweite," half of the "core," or "Kernelwidth" or "Kernel-diameter."

† Fig. 3 and its corresponding stress has been determined by the use of an article and tables published by Professor KECK in the "Journal of the Hanovarian Architects and Engineers' Society" of 1882 under the title "Excentrische Druckbelastung ausserhalb des Kernes bei Mauer Werks Körpern ringförmigen Querschnittes," page 627, *et. seq.*

on the extreme windward side, which is an impossibility. In reality, the resisting area of the foundation is reduced to a shape as shown in Fig. 3. So much of the area of the foundation as lies to the left of the zero line, or neutral axis, is inactive, and the real compressive force on the leeward edge will amount to 18.2 tons, or *twice as much as is permissible.*

Explanation of stress diagram, Fig. 2; on line $A\ B$ equal to 54 ft. lay off from center C of figure, amount of fraction q = 6 ft. 9 ins. marked q, q on right and left. Locate center of pressure P_1 11 ft. from same point, and draw normals to $A\ B$ through $C_1\ P_1\ A$ and B. On the normal through C lay off from C, amount of mean intensity of pressure per square foot = 6.42 tons = CD. From point g on left side draw a line passing through D and intersecting the normal through center of pressure in E; then $E\ P$ = amount of pressure in leeward edge B, which is produced thereto by means of line Ep; $Bp = EP$. Draw a line from p through D, and prolong to intersect with normal through A, and mark p_1, then Ap_1 = tension (in this case) at windward edge. Line $p\ \ Dp$ in conjunction with base line $A\ B$ represents the uniformly varying stress in point $A\ B$.

The above investigation goes to show that the mere application of the law of the lever of "theoretical mechanics" is a fatal deception in structures of this character and would be applicable only if *absolutely rigid* bodies entered into the construction. Engineers have found by practical experience and proper mathematical investigation that the theoretical fulcrum of stability yields or moves to a point where the weakness of the material puts it so that it will not be crushed or torn, as the case may be.

This position is defined under condition I., and determined by the value of the fraction q.

It goes to show further that the proper design of the shape of a structure of this kind can be determined only by *repeated careful trials*, which certainly cannot be considered a waste of time or money in works of such importance and magnitude, and which may cost hundreds of thousands of dollars.

It occurs to the writer that in view of the stated facts the shape of the submerged portion of the "Diamond Shoals Lighthouse" requires material modification, if the most unfavorable conditions are assumed; and such are always the proper ones to assume, if it is ever possible for them to occur. As to what this shape should be I refer to the remark just preceding.

Stability would have been indicated in the design, as to *position* only, if the "resulting force" of wind, wave and weight of tower would have passed through the "kernel" point q on the leeward side, *i. e.* if point P had coincided with point q, Fig. 1. In this case the maximum pressure on the leeward edge would have been 2 × 6.4 tons = 12.8 tons per sq. ft. on the supporting sand foundation. If this would be considered still a safe pressure the lighthouse would have been stable in all three respects as named under I., II. and III.

Respectfully yours,

EWALD SCHMITT, C. E.,
2235 13th St. N. W., Washington, D. C.

[The substance of our correspondent's method of discussing the problem is that which we have already declared to be the proper one, in our opinion. We do not attempt to check the details of the computation.—ED. ENG. NEWS.]

Panel Concentrations Due to Engine Loads.

PHOENIXVILLE, Pa., Nov. 4, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: As in the future engine loads will no doubt be used in all cases in proportioning parts of iron and steel bridges, it may be of interest to the readers of your paper, especially to bridge engineers, to know how to find panel concentrations in an easy and convenient way.

Referring to the moment diagram of the Phœnix engine, as made by the writer for the Phœnix Bridge Co. in 1885 and as now generally used in the latest editions of books on bridge engineering, we use the following notations:

R_0, R_1, R_2, R_3, R_4, etc., panel concentrations.

M_1, M_2, M_3, M_4, etc., sum of all moments about the last wheel in front of panel (1), (2), (3), (4), etc., respectively.

$\Sigma W_1, \Sigma W_2, \Sigma W_3$, etc., sum of all loads, including said last wheels; a_1, a_2, a_3, a_4, etc., distance of said last wheels from corresponding panel points.

l = panel length.

Considering panel point (1), we have as part of reaction R_1, due to the loads to the left of panel (1):

$$R_1\, l - \Sigma W_1 - R_0 = \Sigma W_1 - \frac{M_1}{l} - \frac{\Sigma\ W_1\, a_1}{l}$$

As the loads to the right of panel point (1) contribute to the reaction R_1 the amount:

$$R_1 r = \frac{M_2 + \Sigma W_2\ a_2 - M_1 - \Sigma W_1\ (l + a_1)}{l}, \text{ we have}$$

for the total reaction:

$$R_1 = R_1\, l + R_1\, r = \frac{M_2 + \Sigma W_2\ \ _2 - M_1 - \Sigma W_1\ (l + a_1)}{l} + \Sigma W_1 - \frac{M_1}{l} - \frac{\Sigma M_1\, a_1}{l}$$

$$\text{(Eq. I.)}\quad R_1 = \frac{M_2 + \Sigma\ W_2\, a_2 - 2\ M_1 - 2\ \Sigma W_1\, a_1}{l} \text{ or if}$$

one wheel stands *over* panel point (1), $a_1 = 0$

$$\text{(Eq. I.}a\text{)}\quad R_1 = \frac{M_2 + \Sigma W\ _2 a_2 - 2\ M_1}{l}$$

This simple equation for R_1 should always be used in finding floor-beam concentrations, saving at least half the time spent in figuring in the usual way, viz., by multiplying each load by its distance from the right and left abutment respectively.

For the panel concentration R_2 we have:

$$R_2 = R_2 r + R_2 l = \frac{M_3 + \Sigma W_3 a_3 - M_2 - \Sigma W_2\,(l + a_2)}{l} + \Sigma W_2 - R_1 - R_0.$$

$R_2 l$ being $= \Sigma W_2 - R_1 - R_0$.

But from Eq. Ia: $M_2 + \Sigma W_2 a_2 = R_1 l + 2\ M_1$.

Therefore, $R_2 = \dfrac{M_3 + \Sigma W_3 a_3 - R_1 l - 2\ M_1 - \Sigma W_2 l}{l} + \Sigma W_2 - R_1 - \dfrac{M_1}{l}$

$$\text{(Eq. II.)}\qquad R_2 = \frac{M_3 + \Sigma W_3 a_3 - 3\ M_1}{l} - 2\ R_1$$

For the panel concentration R_3 we have:

$$R_3 = R_3 l + R_3 r = \frac{M_4 + \Sigma\ W_4\, a_4 - M_3 - \Sigma\ W_3\,(l + a_3)}{l} + \Sigma\ W_3 - R_2 - R_1 - R_0.$$

But from Eq. II.: $M_3 + \Sigma W_3\, a_3 = R_3 l + 2\ R_1 l + 3\ M_1$.

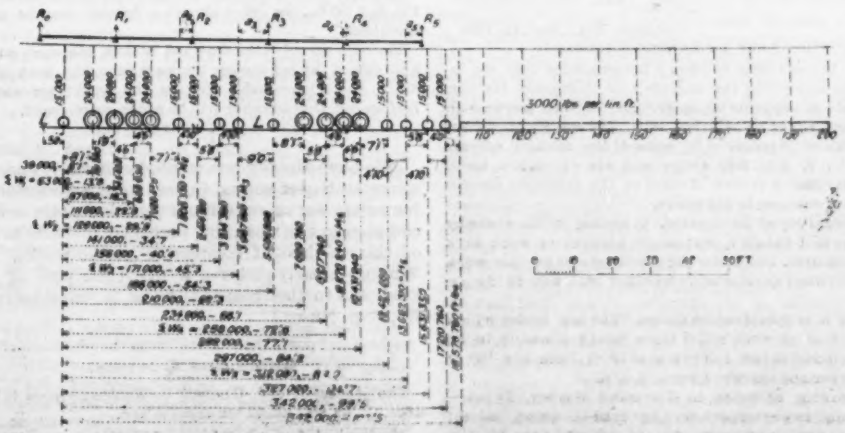
Therefore,

$$R_3 = \frac{M_4 + \Sigma W_4\, a_4 - R_3 l - 2\ R_1 l - 3\ M_1 - \Sigma\ W_3 l}{l} + \Sigma\ W_3 - R_3 - R_1 - \frac{M_1}{l}$$

$$\text{(Eq. III.) or,}\quad R_3 = \frac{M_4 + \Sigma\ W_4\, a_4 - 4\ M_1}{l} - 3\ R_1 - 2 R_2$$

In a similar way may be found,

$$\text{(Eq. IV.)}\qquad R_4 = \frac{M_5 + \Sigma\ W_5\, a_5 - 5\ M_1}{l} - 4\ R_1 - 3\ R_2 - 2\ R_3$$



MOMENTS FOR PHOENIX STANDARD LOCOMOTIVES.

Generally for a train of engines, we have for any panel concentration

$$\text{(Eq. V.)}\quad R_n = \frac{M_{n+1} + \Sigma\ W_{n+1}\, a_{n+1} - (n+1)\ M_1}{l}$$

$$n\ R_1 - (n-1)\ R_2 - (n-2)\ R_3 - \ldots\ldots\ldots\ldots - 3\ R_{n-2} - 2\ R_{n-1}$$

If two adjoining panels are of unequal length, as is the case in viaducts, where above a height of say 50 ft. alternate 30 ft. and 60 ft. long bays prove to be most economical, we have for R_1:

$$R_1 = R_1\, l + R_1\, r = \frac{M_1}{l_1} + \frac{M_2 + \Sigma W_2\, a_2 - M_1 - \Sigma W_1\ l_2}{l_2}$$

or making $\dfrac{l_2}{l_1} = n$ and $l_1 = \dfrac{l_2}{n}$

$$\Sigma R_1 = \frac{M_2 + \Sigma W_2\, a_2 - M_1 - \Sigma W_1\, l_2 - n\, M_1}{l_2} + \Sigma W_1$$

$$\text{(Eq. VI.)}\quad R_1 = \frac{M_2 + \Sigma W_2\, a_2 - M_1\,(1 + n}{l_2}$$

Making $l_2 = l_1 = l$ and $\dfrac{l_2}{l} = 1$, we have

$$R_1 = \frac{M_2 + \Sigma W_2\, a_2 - 2\, M_1}{l}, \text{ which equation is the same}$$

as Eq. (Ia) as it should be for two equal panels.

APPLICATION: If panel concentrations should be needed for a bridge with 20 ft. long panels, using the Phœnix engine diagram in position as shown, we have:

M_1 =	345,450 ft. lbs.	M_2 =	1,806,330 ft. lbs.
2 M_1 =	690,900 "	M_3 =	3,967,860 "
3 M_1 =	1,036,350 "	M_4 =	9,270,240 "
4 M_1 =	1,381,800 "	M_5 =	13,862,310 "
5 M_1 =	1,727,250 "		

a_2 = 3.9	ΣW_2 = 126,000 lbs.	$\Sigma W_2\, a_2$ =	491,400 ft. lbs.
a_3 = 8.5 ft.	ΣW_3 = 171,000 "	$\Sigma W_3\, a_3$ =	1,453,500 "
a_4 = 1.2 ft.	ΣW_4 = 258,000 "	$\Sigma W_4\, a_4$ =	309,600 "
a_5 = 4.8 ft.	ΣW_5 = 512,000 "	$\Sigma W_5\, a_5$ =	1,497,600 "

Therefore

$R_1 = \dfrac{1,806,330 + 491,400 - 690,900}{20}$ = 80,341 lbs. per panel per track.

$R_2 = \dfrac{3,967,860 + 1,453,500 - 1,036,350}{20}$ = 160,682 − 58,568 lbs.

$R_3 = \dfrac{9,270,240 + 309,600 - 1,381,800}{20}$ = 241,023 − 117,136 = 51,743 lbs.

$R_4 = \dfrac{13,862,310 + 1,497,600 - 1,727,250}{20}$ = 321,364 − 175,704 − 103,486 = 81,079, lbs., etc.

P. L. SZLAPKA,
Assistant Engineer Phœnix Bridge Co.

Locomotive Engine Performances.

COLONIA, Uraguay, Sept. 26, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I have lately read Mr. WELLINGTON'S book on "The Economic Theory of Railway Location," and I want to thank him for much valuable information I have gained from it. It has opened my eyes to a good many points about building and operating railways that I had not thought of before. While making this acknowledgement I want to point out a few errors I have noticed, and which I do not see on the "list of errata" accompanying the volume.

In paragraph 191 it is said that the tendency is to fix all train wages by the miles run, and that a limit is fixed, varying from 26,000 to 35,000 miles, as a month's work. This should read 2,500 or 3,500 miles would constitute a month's work, or 26 trips on the 100-mile division. [This error appears only in the first edition; it is corrected in all the others.—ED.] A freight-engine or train-crew that make anywhere between 26 and 30 trips over a 100-mile division consider that they have done a fair month's work, and a passenger-engine or train crew that make from 4,000 to 5,000 miles per month are doing all the work they should. Unfortunately, business is not so good on most roads as to allow even so much average work as this to train and engine-men.

The next thing I wish to mention is a statement in paragraph 344: "Every part of a locomotive, even to the lagging, is hot enough to burn the hand even in the coldest weather." It would be a very poorly lagged boiler that would do this. I have frequently seen and run engines in cold winter weather whose jackets would be covered in some places with snow and ice, and I never knew a jacket to be so hot in cold weather, out of doors, as to burn the hand unless the lagging was burned out from underneath, which is frequently the case however with engines that have been a long time out of the shop—more especially those with diamond stacks. But much better and more complete lagging is needed for locomotives. [The author stands corrected if this correction is correct. He has never had the pleasure of seeing a boiler so well lagged that ice and snow would stick *to the lagging*, nor on which the lagging was not hot to the touch; but perhaps this is due to insufficient observation.] A wrong impression is conveyed in this same paragraph also

(344) when it is said: "As a consequence" [of this poor protection of boilers and cylinders from radiation of heat] "the average amount of fuel consumed in winter is shown . . to be . . . about 20% greater than in summer." This is modified of course by what is said afterward on the next two pages. But I like much better what is said in par. 632 to 638. I think the conclusions there expressed quite right, that increased train resistances are more responsible than anything else for the increased coal consumption of locomotives in cold weather. It certainly is the chief cause, and is due almost entirely to the fluid friction of the congealed oil in contact with the surfaces of journals and bearings, which not only causes trains to offer greater resistance to being pulled along on level road and up hill, but necessitates the use of steam to maintain the desired speed while descending hills that in summer trains run down freely, at the desired speed, several miles without any assistance from the engine, steam being shut off at the top of the hill. In this, and another way, the necessary use of steam up closer to stopping places than is necessary in summer, virtually lengthens the distance over which trains are pulled 15 or 20 miles in a day's run. This extra work often consumes a ton of coal.

In a little book I have written on economical methods of handling locomotives, a copy of which I send you by this mail,* you will notice that somewhat different ground is taken on the gain resulting from leaving off the injection of water to locomotive boilers in emergencies of forced work. But the questions discussed are not identical, as I discuss means of saving fuel, and not means for eking out deficiency of boiler power. The gain for the former results from a decrease in the necessary rate of combustion. It is like an inch more or less on a man's nose; it isn't so much in itself, but it is *where* (*when* in this case) it is applied. An instance from my experience while I was running a locomotive: I am pulling a heavy freight train. I am stopping for a railroad crossing, a half mile north of Saunemin, on the Wabash. In front of me is a stiff, hard pull for a little over a mile, and then several miles of a descending grade, over which I ran in summer with steam shut off. By having my boiler sufficiently full of water (and not too ful which is always possible here, I can leave off all injection of water into my boiler until I get to the top of the hill in front of me, and yet have as much water in my boiler as safety and propriety require. Have I saved anything by this? By so doing I have reduced the coal consumption of my engine one half, while it was struggling up the hill. Instead of my fireman having to put into the furnace *six* "fires" of four shovelfuls of coal each, about 336 lbs., he has kept up 145 lbs. steam pressure with *three* "fires," 168 lbs. of coal, I have saved 168 lbs. of coal. While running the next few miles with steam shut off I recuperate my store of water in the boiler, and thus utilize steam (or heat) that would otherwise be wasted through the safety valves and by guarding against fluctuating steam pressure in my boiler I avoid all possible injury to same.

"But," you say, "although you did leave your injection off while going up the hill, your fire had to furnish the latent heat of steam, at this pressure 856 H. U., for each pound of water you used; and this was nearly three-fourths of what it would have to furnish had you kept your injection on, and maintained your water level. Your fire having to furnish nearly three-fourths as much heat, how could your coal consumption be reduced one-half?" Again, the inch on the end of the nose. Although what you say is true, the saving is effected; and is due also, in part, to the fact that by getting up the hill with 3 "fires" less than under different conditions, I have kept my fire-door from being opened 12 times to put in coal, in which case it would have been kept open about 4 seconds each time, 48 seconds in all; and thus I have kept out of my furnace the immense volume of cold air that else would have been drawn through it by the sharp exhaust at such times and materially reduced its temperature, and which would have noticably (on the steam gauge) reduced the pressure of steam in my boiler. I have done this hundreds of times.

The amount of coal saved is a small matter, only a few shovelfuls. But a few shovelfuls saved on this hill, and a few more on each of several other hard pulls, the use of steam with as short a cut-off as possible while doing all work, and, during the day's run, my fireman, my engine and boiler, and myself have had an easier day's work than we would have had otherwise, and have saved fully a ton of coal that else would have been needlessly wasted. I am sorry to see the views expressed which appear in par. 452, 563, 583 and 588 of "Railway Location," in regard to the economy of high pressure steam and early cut-off. I see by a recent editorial in ENGINEERING NEWS on compound locomotives that you still hold these views. I cannot say much more than I have already said in my chapter on use of steam to cause you to think differently. Of course I think you are sincere, but I know you are misinformed. From a practical experience of fourteen years with locomotives, twelve years in the cab as fireman and engineer, on seven of the prominent Western roads, I am sure you are quite wrong.

The length this letter has already attained forbids any lengthy discussion of this point, but I commend to you what is said on page 100 of the "Manual," and the first paragraph on page 101. The diagrams given were taken from engine 135, C., B. & Q., a class H engine, such as you illustrated recently in your paper.

In 1889 a record was prepared of the economy of different engines which I ran on different divisions of the Wabash. It is the record of the motive power department of that road. In these tests I ran several different types of engines successively, and the results are compared with 7 to 11 other engines of the same type in simultaneous and similiar service. They show an average saving of 2,777 lbs. of coal for every 100 miles run, or an average monthly saving of 37 tons, or $55.50, as compared with the average performance of all other engines of the same type and in the same service. This saving was not effected by any difference of engines, for there was none, but simply by the difference in *care* used to cut off as early as possible rather than to throttle, and to feed the boiler and fires carefully.

This record proves that the methods of locomotive operating that ANGUS SINCLAIR and I, and many other well-informed practical men advocate, effected a considerable saving on a small scale; *i. e.*, in comparison of one with several locomotives. Whether or not it works well on a large scale (several hundred locomotives), you might ask Mr. G. W. RHODES, of the C., B. & Q., as the locomotives of that company are being operated according to instructions I spent the year 1889 in giving to the engine men.

GEORGE H. BAKER,
Master Mechanic Uruguay Western Ry.

[It will be perhaps one of the boons from the compound engine that it will settle the dispute which has endured for two generations as to whether there is or is not any great gain from early cut-offs of locomotive engine. The very fact that compound engines are proposed and prove effective in saving steam (which they do purely and only by reducing the range of expansion in one cylinder) is a proof that there is a great practical loss as well as gain from attempting high rates of expansion in a single cylinder, and we believe the views to which our correspondent objects are sound, to the effect that there is no saving of steam whatever in attempting to cut off earlier than ⅜ to 40% of the stroke, except at very high speeds. This seems to be positively proven by the undoubted fact that an engine using steam full stroke, and not cutting off at all except as the necessary lead may require it, will devop a horse-power from 34.62 lbs. of steam, and that good ordinary work from a locomotive ranges nearer to 30 lbs. than 25 lbs. We anticipate, therefore, that the unquestioned economy shown by our correspondent's records arose in part from avoiding extreme practice in respect to throttling rather than cutting off early, but mainly from more careful handling of the fire, water supply and engine generally.

One of the statements objected to by our correspondent is, perhaps, too strongly expressed, viz.: "in the locomotive the steam is usually permitted to expand through about half the stroke. The theoretical gain from doing this is large, but the practical gain small, so small that nearly all that is gained by it is to neutralize the various practical obstacles to realizing the full theoretical work of steam at full stroke." This is, perhaps, too strongly expressed, and yet, steam at half stroke ought theoretically to develop a horse-power hour from 20¾ lbs. of steam. Is it not practically nearer to 30 lbs.?—ED. ENG. NEWS.]

Improving Entrance to Galveston Harbor.

VELASCO, TEX., Nov. 11, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of Nov. 1, proposals for bids are invited for improving the entrance to Galveston Harbor, under the act appropriating $500,000 for that purpose in the recent River and Harbor bill. The specifications for this work were prepared by some of the ranking officers of the U. S. Engineer Corps and are of such a novel character that a review of some of the principal clauses may be of interest to engineers.

The usual object to be gained in letting public works by contract is to obtain a maximum amount of work at a minimum cost, but under the specifications for this work it is somewhat questionable whether such will be the result.

Clause 16 of specification states, "The law under which the contract for work under these specifications is to be made is found in the following extract from the River and Harbor act approved Sept. 19, 1890.

"Improving entrance to Galveston Harbor, Texas.—Continuing improvement, five hundred thousand dollars; provided that contracts may be entered into by the Secretary of War for such material and work as may be necessary to carry out the the plan contained in the report of the Chief of Engineers for 1886, for the improvement of that harbor, to be paid for as appropriations may from time to time be made by law."

The work will be continued or resumed as appropriations may from time to time be made by law, and the work, including delivery of material in place, must be vigorously pushed at such rate that the contractor shall earn not less than one million dollars per year, provided appropriations to that extent or at that rate are made by Congress. Should a less appropriation be made at any one time the contractor must perform work under it and to the extent it admits within a proportionally less time.

Clause 18.—The works will not be considered *completed* until they shall have been *maintained a period of five years after construction.* Whenever repairs become necessary the engineer officer in charge shall notify the contractor of the character and approximate quantity of the material required, and the contractor shall within thirty days from date of such notification, begin the delivery of the material and shall push the work of repair with diligence."

Clause 21.—At the end of each calendar month or as soon thereafter as the necessary formalities can be complied with, payment will be made for work accomplished during the month, less 10% of its contract price. The retained per cent. does not become due until the completion of the works.

From the above it will be seen that the duties of the engineer in charge will be simply that of inspector and disbursing officer, and that the contractor must take all responsibility of detail of construction and maintenance of the works.

Under the rate of progress required in the specifications six years will be the minimum time in which to complete the work, and as the jetties must be maintained for five years after completion before a final settlement can be made, the retained percentage of the contract price ($600,000) will not be due until at least eleven years after the commencement of the work. This, with the fact that bidders must take into consideration the fluctuations in the cost of labor and material for a period of eleven years in the future, make it absolutely necessary to add a large percentage for contingencies to all estimates. No ordinary plant can be expected to last for eleven years in the climate on the Texas coast and consequently allowance must be made for at least one removal during the time of contract.

As shown in the specifications no work can be done until after appropriations have been made to pay for the same, and from this it would seem that the only object gained by making the contract cover the entire work is to morally bind the government to fully complete it and thus create a basis for a boom in Galveston city lots.

There is no question that were the bids to be simply for the labor and material that can be obtained for the $500,000 already appropriated, the amount would be at least 25 per cent. more than will be obtained under these specifications.

This will probably hold true for all future appropriations, and consequently the final total cost of the improvement will be 25 per cent. more than it should be. This seems a pretty high price for the government to pay to inaugurate a boom, yet the history of this appropriation rather indicates that it has been one of the main objects in view from the start.

The plans to be carried out are those of the U. S. Engineer Board of 1886, which require the building of jetties 7,000 ft. apart and extending out to the 30-ft. contour on the outside of the bar.

The distance between the 30-ft. contours on the inside and outside of the bar is about 20,000 ft., and the amount of material to be excavated or scoured out to produce a 30-ft. channel through this bar will exceed 30,000,000 cu. yds., or a sufficient quantity to decrease the depth of water 3 ft. over an area of 10 sq. miles in front of the works.

As the slope of the gulf bottom outside of the bar is only 1 ft. in 3,100 ft., the effect of such a deposit may be easily surmised.

The average advance seaward of the contours on the gulf side of the bar during the past year has been about 350 ft., and it is probable that as the works are carried farther out this advance will be much more rapid.

Very truly yours,
GEO. Y. WISNER.

[We have already commented editorially upon the uncertainties of annual Government appropriations for public works covering a period of years in their completion and upon the necessary increase in cost of this method of conducting public works. Mr. WISNER clearly pictures a particular case of this kind, and further comment by us is unnecessary.—ED. ENG. NEWS.]

Notes and Queries.

The address of Mr. GEORGE S. EDMONDSTONE is Defiance, O., or was about six months ago.

Mechanical Cement Stirrer. In answer to query on page 467 of this journal, Mr. S. BENT RUSSELL, of the St.

* "A Manual of Instruction for the Economical Management of Locomotives, for Locomotive Engineers and Firemen." By GEORGE H. BAKER. Chicago, Rand, McNally & Co. 16mo. pp. 122.

Louis Water-Works Extension, 77 E. May St., St. Louis, writes as follows: A mechanical cement stirrer, devised, by Mr. RUSSELL, is being used on those works for gauging neat cement. Several hundred tests have been successfully made with it. Its advantages are—less skill required than in hand gauging; the briquettes are made more easily and in less time, and the results seem fully as reliable as when gauged by hand. A description of the apparatus will be published shortly by Mr. RUSSELL. It is known as the "jig."

The Secretaryship of the Am. Soc. C. E.

In addition to obtaining the opinion of Mr. JAS. W. HAWES as to the eligibility of an Associate to office in the Am. Soc. C. E. if duly nominated and elected, published in ENGINEERING NEWS of Nov. 22, 1890, the editors of this journal thought it well to obtain another independent opinion from another eminent firm of counsel, which, they were informed, had made somewhat of a specialty of questions of this nature, involving the construction of corporate, club and society by-laws. For this purpose we addressed the following letter to Messrs. SHEPARD, OSBORNE & PRENTISS, counselors, 10 Wall St., New York, asking for the opinion which is subjoined to it:

We send you herewith a volume containing the Constitution, Appendix, Form of Application for Membership, etc., of the American Society of Civil Engineers; also an undated circular issued by the Board of Direction about Nov. 17, containing the nominations made by the Nominating Committee, in which circular occurs the following:

"The Board of Direction is of the opinion that Mr. JOHN C. TRAUTWINE, Jr., Assoc. Am. Soc. C. E., is not eligible under the Constitution to be the nominee of the Nominating Committee for the office of Secretary."

We desire your opinion upon the following questions:

1. Does the fact that Mr. JOHN C. TRAUTWINE, Jr., is an "Associate" and not a "Member," as described in Article II., Section 3, of the Constitution of the American Society of Civil Engineers, render him ineligible as Secretary of such Society, the Secretary being, under Article V. of such Constitution, also a Trustee?

2. At what time must the candidate be a "Resident"—at the time of nomination, election, or assuming office?

3. Is it within the functions of the Board of Direction to pass upon the qualifications of candidates, or are they bound by the action of the Nominating Committee?

Law Offices, Shepard, Osborne & Prentiss,
10 Wall St., NEW YORK, Dec. 1, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: We are in receipt of your favor of the 25th November, and have the honor to submit the following:

The American Society of Civil Engineers is organized under the laws of New York, Chapter 319 of 1848, Section 3 of which provides that the Society may annually elect *from its members* its trustees, directors or managers, and under its constitution the Secretary is *ex-officio*, a trustee. Hence it is clear that membership is a necessary qualification of the Secretary, and, the act itself being silent, the question what constitutes membership is to be determined by the constitution of the Society.

One of the chief rules of construction is that an instrument must be construed as an entirety, and effect given, if possible, to all its parts. (Co. Litt. 381, a. 1 Kent's Com. 462; Ward v. Whitney, 8 N. Y., 416; People v. Draper, 15 N. Y., 558; Westcott v. Thompson, 18 N. Y., 366; Moore v. Jackson, 4 Wend., 67.)

There is some apparent conflict between different provisions of the constitution, but it is verbal merely, and disappears upon applying the above rule.

Article VII., Sec. 4, provides "a nominating committee shall be appointed. . . . This committee shall present to the Board of Direction the names of persons selected by them as candidates for officers. Of these at least one Vice-President, three Directors, the Secretary and Treasurer, shall be Resident Members."

It is apparent that the clause "of these, at least one Vice-President, three Directors, the Secretary and Treasurer shall be Resident Members" qualifies the word "officers" in the preceding sentence, and not the word "candidates;" because, if it be held to qualify the word "candidates," then, while under Section 6 of the same article, both Resident and Non-Resident Members could be nominated and elected to these offices, only Residents would be entitled to the very great advantages of a nomination by the Nominating Committee. This would be an unreasonable and useless discrimination against Non-Resident Members. If, on the other hand, the clause be held to qualify "officers" and to make Residents only eligible to those offices, this absurdity is removed and the different provisions of Article VII. become consistent, permitting the Nominating Committee as well as the "five members" mentioned in Section 6 to nominate from either class; while requiring that said five officers shall be elected from the Residents, while the other five may be elected from Residents or Non-Residents. Bearing in mind then that the Secretary is *ex-officio* a trustee, and that the act requires the trustees to be *elected from among the members*, it follows that the Secretary must be at the time of his election, a Resident Member.

The question then arises, What is the meaning of the term "Resident Member?" Is it used in a broad sense as distinguishing the members of the Society from strangers, or in a narrow sense as defining a class of members?

There would be no question except for the fact that Article II., Section 2, provides "The Active Members of the Society shall be divided into three classes, to be styled respectively Members, Associates and Juniors. Associates and Juniors shall possess all the rights and privileges of Members, excepting the right of voting."

Where and for what purpose shall they be so styled? And why was this distinction made in the classes of active members of this Society? Clearly for the purpose of fixing the grade of engineers in the profession, they being divided into Members and Junior Members, and of distinguishing by appropriate words the professional engineers from those following some other calling, associated more or less with that of engineering. The Constitution requires a "Member" to be an engineer of long practice and great skill; an "Associate" to be engaged in some other business, a "Junior" to be an engineer of not less than one year's practice. If the word "Engineer" be substituted in place of "Member," as the name of the highest grade, the meaning of the Constitution becomes apparent, and all confusion vanishes.

This Society has a strong resemblance to the old time "Guild," and it would be manifestly unjust to the public as well as to the engineers to place Engineers, Associates, and Juniors upon the same footing before the public, or to permit Associates and Juniors, on the authority of the Society, to be styled, "Members of the Society of Civil Engineers," for the public would have the right to infer that a person so styled was an engineer of experience and skill, and therefore the Board of Direction, *so construing the Constitution*, has declared that the authorized abbreviations to be used by "Members of the Society," having occasion to designate themselves *as such*, shall preserve these distinctions. (Page 19, Constitution, 1890.)

But there can be no doubt that "Associates" and "Juniors" are members of the Society, and that in the management of its internal affairs all three classes stand on the same footing, except that the "Engineers" (of the higher grade) are clothed with the right of voting.

The object of the Society, among others, is stated in Article I. to be the establishment of a central point of reference and union for its "members." No one will claim that Associates and Juniors are not entitled as members to the advantages of this "central point."

Article II. is entitled "Membership." Section 1 provides that engineers and other persons who by profession are interested in the advancement of science shall be eligible for admission in their appropriate class. The conclusion is inevitable that when admitted to membership in their respective classes of Members, Associates and Juniors, they all become members of the Society.

Section 2 provides that the active members shall be divided into the three classes mentioned. An Associate is an active member of the Society. It goes without saying that an Active Member is a Member.

Nowhere in the constitution and by-laws is the word "member" used in the restricted and narrow sense of "engineer" (Art. II., Sec. 3) without something in the context showing that it is so used.

The word "Member," in its broad sense, is used throughout this very article which, in Section 3, explains the use of the word in the narrow sense; Section 5 provides that any person, whether Member or otherwise, may become a "fellow," and that Members who become Fellows shall in addition to all the rights they possess as members be entitled to receive duplicate copies of all publications, etc. We are here informed that Associates and Juniors receive, *as members*, copies of all publications of the Society.

Article III. is entitled "Admissions and Expulsions." It provides in Section 1 for the admission into the Society of all three classes of members, and for the transfer of members from one class to a "higher," *i. e.*, from "Juniors" to "Associates," and from "Associates" to "Members" or "Engineers." Section 8 provides that on being elected the candidate must subscribe the constitution and by-laws, and pay his entrance fee and yearly assessment, when he will be entitled to receive a certificate of "membership," and Section 10, that "every person admitted to the Society shall be considered as belonging thereto, etc."

If Associates and Juniors are admitted to the Society and are to be "considered as belonging thereto," it is difficult to imagine them as occupying any other *status* than that of membership.

We are also informed that the Society in its practical construction of this article has treated the word "member" as having its broad meaning wherever it occurs, except in those instances where the reference is clearly to members having the right to vote as members.

The practical construction given to an instrument by those interested in and acting under it is of great importance in determining its meaning. (Kingsland vs. The Mayor, 45 Hun, 198; Stewart vs. Patrick, 68 N. Y., 450; Danziger vs. Boyd, 53 N. Y. Super, 400.) Throughout the whole of Article IV., entitled "Dues," the word "member" is used in the broad sense, as including Associates and Juniors. If they are members for the purpose of paying dues, surely they are members for the purpose of holding office, unless excluded by express words or unavoidable inference.

A careful reading of the remainder of the constitution, of the appendix, of the form of application for membership, of the schedule of fees and dues, the remarks thereon, and of the code of rules for awarding the "Norman Medal," shows that in every instance where the word "member" is used it has its broad meaning, unless something in the immediate context shows that it is used to distinguish one class of members from the others, and this, we are informed, has been the practical construction given to the word by the Society in such instances.

We are, therefore, of the opinion that Mr. TRAUTWINE is not rendered ineligible by reason of being an Associate, and this upon the broad ground that an Associate is a member of the Society.

It was the evident intention of the Society as expressed in the constitution, and to be inferred from its name, to keep the control of its affairs and shaping of its destiny in the hands of engineers of high grade, and therefore they only were clothed with the elective franchise. But the officers are the mere instruments selected to carry out the purposes of the Society and are its agents, and the right of the body in whom the power to choose agents is vested, to select them at will, should not be abridged by implication, nor should Associates and Juniors be deprived, by implication, of their right to act as agents if selected.

But in addition to the foregoing the constitution, after defining the word "Members" in its narrow sense, expressly provides, "Associates and Juniors shall possess all the rights and privileges of Members, excepting the right of voting;" that is, that the Associates and Juniors shall possess all the rights, not of "members" in the broad sense, because the constitution has just said that they are active members, but, the rights of members in the narrow sense, meaning "Engineers." Now how can an Associate be entitled to all the rights and privileges of the "Engineers," excepting the right of voting, if he is to be excluded from office?

There is no difficulty of disposing of the objection that the Secretary votes as a Trustee, because the right of voting here spoken of is evidently voting as a member of the Society. One might as well say that an Associate was excluded by this section from voting for Governor of the State.

It is apparent then that the word "member" is used in Article VII., Section 4, in the broad sense to distinguish members from strangers.

We are also of the opinion that it is not within the functions of the Board of Direction to pass upon the qualifications of candidates to be nominated by the Nominating Committee, because the constitution requires the Board to cause the list presented to them by the committee to be posted, and to issue a letter ballot containing the names thus proposed.

Your obedient servants,
SHEPARD, OSBORNE & PRENTISS.

Fire Risks and Mill Construction.

During the past year the Boston Manufacturers Mutual Fire Insurance Co. has issued, in addition to the annual report and list of fires, the following circulars on matters pertaining to the interests of the insured, chiefly on technical questions, which have not been distributed except in case of correspondence or interviews relating to the subject. Any of the following will be sent on application to any person connected with property insured in any of the Factory Mutual Companies.

No. 27. Non-conductors for steam pipes.

No. 28. Hazard from outside electric currents.

No. 29. Storage of oil.

No. 30. Valves to automatic sprinklers and inspection of hydrants.

No. 31. Storehouse construction and protection.

No. 32. Rules for electric lighting and motive apparatus.

No. 33. Slow-burning construction and strength of floors.

No. 34. Blank forms for keeping a full account of insurance policies year by year.

Plates illustrating methods of mill construction, as follows, have been prepared anew, or early ones changed in order to introduce modifications which have been developed by experience.

No. 1. Standard mill construction.
Electric light station.

No. 2. Timber store house.

No. 3. Two-story timber work shop.

No. 4. One-story mill, plan and details of construction.

No. 5. Examples of one-story construction especially adapted to machine work.

The list illustrates how much excellent technical work is done by this company.

The Miner's Inch of Water in the United States.

In the mining and irrigating sections of the United States water is sold by the miner's inch, which is theoretically the quantity of still water which will flow through a given aperture in a given time and under a given pressure. It was an arbitrary measure adopted in the early days of mining by ditch companies, and the standard was one established by the law of each mining camp for itself. As a result, the miner's inch differs in different localities, in the size of opening, pressure and mode of discharge.

As much confusion exists as a result of this mixed practice, the following table will be interesting. It is taken from Vol. II. of Prof. EGLESTON'S "The Metallurgy of Silver, Gold and Mercury in the United States."

THE MINER'S INCH.

Definition Legally Accepted.	Total No. of definitions.	Arizona.	California.	Colorado.	Dakota.	Georgia.	Idaho.	Montana.	N. Carolina.	Oregon.	S. Carolina.	Utah.
Stream of water passing through "A sq. in. orifice under 6-in. head," thickness of partition and point from which pressure is measured, whether top, center or bottom of orifice, not stated	97	1	20	10	11	5	1	11	..	38	..	..
"A sq. in. orifice under 6-in. head, above top," thickness of partition not stated	1	..	..	..	..	..	..	..	..	..	..	1
"A sq. in. orifice, under 6-in. head, measured from center; 2-in. plank"	3	..	3	..	..	..	..	..	..	..	..	..
"A sq. in. orifice under 6-in. head," point from which pressure is measured not stated; 2-in plank	7	..	7	..	..	..	..	..	..	..	..	..
"A sq. in. orifice under head from 4 to 6 ins."	2	..	2	..	..	..	..	..	..	..	..	..
"A 1-in. square orifice under 4-in. head"	7	..	3	..	..	4	..	..	..	..	..	..
"An orifice 2 in. high under 5-in. head," delivering 2 miner's inches per inch in width of orifice	1	..	1	..	..	..	..	..	..	..	..	..
"An orifice 2 ins. square under 6-in. head from center "=4 miner's inches	1	..	..	..	..	..	..	..	..	1	..	..
"An orifice 3 ins. high under 3-in head," delivering 3 miner's inches per inch in width	9	..	..	..	..	..	..	..	..	9	..	..
"An orifice 3 ins. high under 6-in head "=3 miner's inches per inch in width	1	..	..	..	..	..	..	..	..	1	..	..
"An orifice 4 ins. high under 4-in. head "=4 miner's inches per inch in width	2	..	1	..	..	..	..	..	..	1	..	..
"An orifice 4 ins. high under 6-in. head, above top of aperture "=4 miner's inches per inch in width.	1	..	..	..	..	..	1	..	..	..	..	..
"An orifice 6 ins high under 3-in. head, above top, single partition "=6 miner's inches per inch in width	1	..	..	..	..	..	1	..	..	..	..	..
A delivery of "10 gallons per minute"	2	..	..	..	..	..	..	1	1	..	..	..
"675 gallons per hour,"	1	1	..	..	..	..	..	..	..	..	..	..
"1.5 cubic feet per minute."	1	..	..	..	..	..	..	1	..	..	..	..
"10 gallons per minute, or water flowing through an orifice 1 in. square in a thin vertical partition, under 5 in. head"	1	..	..	..	..	..	..	..	..	..	1	..
Running inch, in cross section of ditch or flume, without pressure	8	..	8	..	..	..	..	..	..	..	..	..
Total number by States and Territories	146	2	45	10	11	9	3	13	1	50	1	1

Dr. EGLESTON says that the definition of the inch most largely used is the amount of water discharged through an opening 1 in. square in a plank 2 ins. thick, with still water standing at a pressure head of 6 ins. above the opening, or 7 ins. over the center The discharge is sometimes flush with the bottom of the reservoir and sometimes raised above it. The thickness of the plank through which the discharge is made is 1 in., 1½ ins. and 3 ins. The lower front end of this discharge is usually chamfered. The height of the water over the orifice, or head, is, however, not a fixed quantity, and is sometimes counted from the center and sometimes from the top, and usually varies from 4 to 6 ins.

The discharge from a 1-in. square orifice through a 2-in. plank, with still water standing 6 ins. above the orifice, was determined by Mr. J. D. HAGUE to be 1.5625 cu. ft. per minute; 93.75 cu. ft. per hour, or 2,250 cu. ft. in 24 hours. Other observers make it 2,274 cu. ft in 24 hours, or nearly 17,000 galls. in that time. Others again make it 16,800 galls. in the 24 hours. Mr. HAMILTON SMITH, in 1874, made one miner's inch in 24 hours equal 2,207.136 cu. ft.; and Mr. A. J. BOWIE, in 1876, made it equal 2,159.146 cu. ft. in the same time. These latter experiments were made to find the value of the inch in actual practice, and the first result was obtained at an elevation of 2,900 ft. above the sea, and the second at 216 ft. above sea level.

Lead Damp-proof Plates for Buildings.

A device, patented by Mr. A. SIEBEL, of Düsseldorf, has been very recently introduced into the United States for the protection against dampness of walls, roofs, foundations, iron construction, etc. As described, the isolation is accomplished by the use of interior leaden plates protected externally by a patented composition made of asphalt, "stibaltar" and sand. These plates are built into the walls horizontally, or into a roof, and effectually cut off the passage of dampness from below or above.

The advantages claimed are: That, while comparatively thin sheets of lead are thoroughly imperishable and impermeable, and best adapted to the purpose in view, they are also easily pierced by sharp objects. To obviate this objection Mr. SIEBEL protects the lead on both sides by a strong and cheaper material, also waterproof. The plates will not crack, can be bent without damage, will settle with the work, and can be easily joined or used over again. The plates, as prepared, weigh about 1¼ lbs. per square foot of surface, and cost about 4 cts. per square foot.

These plates have been used most satisfactorily by European builders, railways and in government works, and in the United States it is said that such architectural authorities as Prof. WARE, Mr. E. H. KENDALL, Mr. W. H. HUNT and Mr. MAYNECKE, with Mr. GEORGE W. POST, have examined it and pronounced it a very good damp-proof material, and as promising well as a fire protection. An agency is to be opened in New York for its sale in this country.

Culm Compared with Other Fuels.

The city of Scranton, Pa., and other towns situated in the immediate vicinity of the mountains of culm, or coal waste, that are to be found in the anthracite coal fields of Pennsylvania, have certain great advantages in fuel. The Scranton Board of Trade claims that it is due primarily to this cheap fuel that that city has increased from 3,000 inhabitants, in 1840, to 100,000 in 1890. The report of this same board contains some interesting comparisons between culm and other fuels as shown in the cost of evaporating a given quantity of water. The results quoted were deduced from carefully conducted experiments of the Edgar Thomson Steel Works, the U. S. Navy Department and other sources of high authority. To evaporate 30,000 lbs. of water it has been found that it takes of

Gas	26,038 cu. ft.
Free burning bituminous coal	3,131 lbs.
Coking bituminous coal	3,166 "
Anthracite, prepared sizes	3,178 "
Pea	4,300 "
Buckwheat	4,273 "
Culm	4,762 "

To get at the real value of the above figures the cost of each class of fuel must be compared as below:

26,038 cu. ft. of gas at 10 cents per 1,000 cu. ft.	$2.60
3,131 lbs. of bituminous coal at $1.50 per ton	2.10
3,166 lbs. of coking bituminous coal at $1.50 per ton	2.12
3,178 lbs. of anthracite at $2.50 per ton	3.50
4,300 lbs. of pea at $1 per ton	1.94
4,273 lbs. of buckwheat at 75 cents per ton	1.44
4,762 lbs. of culm at 10 cents per ton	.22

If to these figures be added the cost of handling the coal and ashes, we shall have the entire cost.

Anthracite, prepared sizes	$4.75
Coking bituminous	3.37
Free burning bituminous	3.35
Pea	3.23
Buckwheat	2.73
Gas	2.61
Culm	1.51

Carrying the analysis still further, it is found that it costs, per horse-power per boiler per day, for

Anthracite coal, prepared sizes, from 5 to 8 cents.
Bituminous coal from 4 to 6 cents.
Natural gas, from 3 to 5 cents.
Culm, from ¼ to 2 cents.

THE AM. SOC. C. E. NOMINATIONS FOR OFFICERS sent in by independent groups of members have proved to be very numerous, as might have been expected from the fact that the circular from the Board of Direction, volunteering the opinion (since shown to be entirely erroneous) that the duly nominated candidate for Secretary was ineligible, and announcing that three other nominees declined the nomination, was issued only 13 days before the time for receiving nominations closed, affording scanty time for conference between different localities. The various tickets nominated, and the other action had, are shown in full in another column.

THE ST. LOUIS ASSOCIATION of the Am. Soc. C. E., or rather 14 individual members constituting the weightier part of that Association, have issued an important and most judicious circular as to the pending election, reprinted in full in another column, announcing that the local associations in several Western cities will probably act to select a common ticket, and asking all members to withhold their vote until some united action can be obtained. They add: "The object of this communication is not to solicit your vote for any particular candidate, but only to inform you of the opportunity you will have of uniting your vote with others, if you should so desire, and will retain your vote until you are informed of this general action."

ANOTHER TUNNEL UNDER THE THAMES, London (Eng.), is proposed. The location is at Blackwall, some miles below London Bridge. The following note is from *Herapath's Railway Journal* (London):

Sir BENJAMIN BAKER, who was instructed by the London County Council to advise upon the practicability of carrying out the Blackwall Tunnel scheme, has at length completed his labors, and his report has been issued to the members of the County Council. It is chiefly based upon observations of tunnels of a similar character in America, one of which has been successfully completed at Sarnia, while the other is in progress under the Hudson River Sir BENJAMIN BAKER, who has only recently returned to England after inspecting these works, concludes from his observations that the proposed tunnel from Blackwall to Greenwich is entirely practicable. In view of the experience already gained, he considers it hardly necessary to carry out any experimental works between Blackwall and Greenwich, more especially as the experiments, to be of any practical value, would cost much more than the $50,000 voted by the County Council for the purpose. Sir BENJAMIN BAKER recommends that in the first place a tunnel should be constructed of sufficient size to accommodate two lines of vehicular traffic, and that foot passengers should be provided for by a separate tunnel.

TWO NEW NICARAGUAN ENTERPRISES, which imply local faith in the early construction of the canal are a horse railway, on which construction has been begun from Las Lajas, the proposed western mouth of the Nicaragua Canal, on Lake Nicaragua, to Rivas, 6 miles, and another 6-mile horse railway from Greytown to the Indian River, which is being built by Hoadly, Ingalls & Co., of New York and New Orleans. GEO. S. GROUT is Chief Engineer.

BALTIMORE'S SHIP CHANNEL is to be widened to 600 ft. and deepened to 27 ft. at low water. Col. WM. P. CRAIGHILL, U. S. Engineers, who has long had charge of the public works in this section, will shortly open proposals for the work on these improvements. The late Congress appropriated $340,000 for this purpose.

AT THE SAULT STE. MARIE, the work of building the temporary dam for the water-power project diverting the North Channel of St. Mary's River is progressing favorably. The dam consists of round timber crib work filled in with clay, gravel and sand, well mixed in equal proportion, puddled and riprapped on the outside. The dam is now about completed. The excavation works for 10,000 HP. head and tail races will be proceeded with, with a view to completing the work before December, 1891. The contract has been let to Mr. LUKE MADAGAN. An English syndicate has been negotiating with this company for the purchase of all rights, lands, plants, etc. Should the negotiations be crowned with success, it is believed that the syndicate will at once widen and deepen the excavations to dimensions which will supply some 30,000 H.P., and by further widening and extending the main tail race, if required in the future, over 100,000 HP.

IMMIGRATION continues very heavy. For the 10 months ending with October the figures are 427,666 against 378,140 last year, an increase of 11.6%. For the month of October the increase is 15.6%. Italian, Hungarian and Bohemian immigration continues to show the largest increase. From the British isles there is a decrease.

THE TOTAL POPULATION OF THE UNITED STATES is officially stated to be 62,622,250. This is compared with 500,155,783 in 1880 and 38,558,371 in 1870.

A CHINESE TELEGRAPH LINE is sanctioned by the Government to connect Pekin with Kiachta, on the Siberian frontier.

ALUMINUM AT 50 CENTS PER POUND is promised for 1892 by Mr. EUGENE H. COWLES, president of the Cowles Aluminum Co., of Lockport, N. Y. The price of this metal in an iron alloy, as made by this company, is now $1 per pound. Mr. COWLES says that in the near future his company will make the pure metal by a new process, "radically different" from other processes and "ridiculously simple." Reagents will be used as cheap as the clay which will form the base. Patents are being applied for and for the present the process is kept secret.

THE SMOKE CLOUD OVERHANGING LONDON is estimated by Prof. ROBERTS-AUSTEN, F. R. S., to weigh 300 tons. Of this volume 50 tons are solid carbon and the remainder carbonic acid gas. He figures the yearly value of its constituent parts as equaling $10,000,000. This item was included in the late report of the sanitary committee of the London City Council on the smoke nuisance in that city.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

New York Central & Hudson River.—Surveys are in progress for a line from Utica, N. Y., via Watertown, to Clayton, N. Y. It is the intention to build the line this winter.

Philadelphia & Reading.—The Northeast Pennsylvania R. R., from Hartsville to New Hope, Pa., has been completed, and construction trains are now running over the line.

Cape Breton.—The eastern section of the Cape Breton railway, between the Grand Narrows of the Bras d'Or lakes and Sydney, was formally opened for passenger traffic Nov. 24. The western section, between the Narrows and Hawksbury, on the strait of Canso, will be opened next month.

Pittsburg, Shenango & Lake Erie.—The terminus of this road, which had been intended for Conneaut Harbor, Ohio, has been secured for Erie, Pa., by a subscription of stock and the gift of right of way. The company is now laying track at the rate of 1 mile per day, and it is expected to have the line completed in 2 months.

Maine Central.—The extension of the Upper Coos R. R. from North Stratford to Whitefield, N. H., 32¼ miles, will be completed by Jan. 1.

Concord & Montreal.—It is reported that this company will build a branch from Jefferson Meadows to Jefferson Hill, N. H., 3 miles.

Baltimore & Ohio.—This company will build a cut-off at Relay Station between Baltimore, Md., and Washington, D. C. The work comprises a large iron bridge and considerable heavy grading.

Wabash.—At a recent meeting of the stockholders an issue of $3,500,000 in bonds was decided upon. The proceeds are to be used in the construction of a line from Montpelier, O., to Hammond Junction, Ind. This will give the company an independent line from Toledo, O., to Chicago, Ill.

Western Maryland.—President Hood in his report to the stockholders, read at the recent annual meeting, gave the following outline of the proposed new extensions of the road and the financial arrangements to cover the cost of improvements:

It was not only the purpose of the company to build the Tidewater R. R. in this city (Baltimore, Md.), but in the same financial operation to provide for extension of the main line from its present terminus at Williamsport up the Potomac River 14 miles to a connection with the Baltimore & Ohio R. R. at Cherry Run; the construction of the eastern extension of the Baltimore & Harrisburg Ry. from Porter's Station, 5 miles east of Hanover, Pa., 15 miles to the city of York, Pa.; a further extension of 14 miles to a connection with the Philadelphia & Reading R. R., near Marietta, Pa.; also, the construction of the Northern, or Harrisburg branch, from a mid-point between Porter's and York, 20 miles, to Bowmansdale, upon the Philadelphia, Harrisburg & Pittsburg R. R. (formerly the Harrisburg & Potomac R. R.). These connecting links, which, with the Tidewater R. R., would embrace 80 miles of new line and cost between three and four million dollars, would not only have the effect of making the Western Maryland independent in this city, and converting its present system of local roads into several through lines, but would prove of great benefit to the Baltimore & Ohio, Philadelphia & Reading and Norfolk & Western roads, in connecting their systems through Western Maryland channels.

Middletown & Cincinnati.—M. D. Burke, of Cincinnati, O., engineer of construction, informs us that about ten miles of the grading and eight miles of the track have been completed on this road. The road will be 15 miles long and is to be in operation early next season.

Vandreuil & Prescott.—Surveys are in progress between Chateau Blondeau and L'Orignal, P. Q.

Projects and Surveys.

New Hampshire.—Notice has been given that application will be made to the next New Hampshire State Legislature for some law which will result in giving the public railway facilities between the terminus of the Manchester & North Weare R. R. in Weare, N. H. and the village of Henniker, N. H.

Cleveland, Canton & Southern.—A railway company by this name has been chartered in Ohio.

Lewiston, Augusta & Camden.—Application will be made to the next Maine State Legislature for a charter to build this railway.

Castine & Bangor.—New York capitalists have become interested in this enterprise, and it is stated that active steps will at once be taken to construct the line. The road will run from Castine to Bangor, Me., 37.7 miles. A. M. Devereaux, of Bangor, Me., is interested.

Portland & Rumford Falls.—The Maine State R. R. Commissioners have been asked to approve the articles of association of this railway company.

Niagara Falls & Lewiston.—A meeting of the stockholders will be held Dec. 23 to consider the proposal to consolidate this company with the Niagara Falls & Whirlpool Ry. Co.

Maryland.—There is talk of constructing a railway from Singerly, Md., south to Easton, Md. From Massey's Station to Chestertown the Baltimore & Delaware Bay R. R. already built will be used. This leaves only the sections from Singerly to Massey's Station, 25 miles, and from Chestertown to Easton, 32 miles, to be constructed.

SOUTHERN.—Existing Roads.

Georgia Southern & Florida.—The Macon & Birmingham R. R. is now in operation from Macon to Woodbury, Ga., and will soon be completed to La Grange, Ga.

Morristown & Cumberland Gap.—This road from Morristown to Cumberland Gap, Tenn., 45 miles is to be completed by Jan. 1. The entire line has been graded and tracklaying is in progress.

Craggy Mt.—W. B. Gwyn, of Asheville, N. C., is president of this road, noted last week.

Kentucky Union.—It is expected to have this road completed to Inverness, Ky., by Jan. 1. The extension to Big Stone Gap, Va., has not been located yet.

Charleston, Cincinnati & Chicago.—Arrangements have been completed for the reorganization of this company, and it is probable that work will be rapidly pushed to completion.

Chesapeake & Ohio.—Engineers are surveying an extension of the Ohio & Big Sandy R. R., formerly the Chatteroi R. R., toward Big Stone Gap, Va.

Charleston, Sumter & Northern.—Nearly all the grading from Sumter to Bennettsville, S. C., 62¼ miles, has been finished and track is being laid at the rate of one-half mile per day.

Alabama Mineral.—It is stated that trains will be run on this road as far down as Shelby within the next 15 or 20 days. Work is not progressing quite as well on the other end of the extension. A considerable quantity of heavy grading has to be done between Shelby and Calera, and it will probably be two or three months before trains are run over the entire length of the extension.

Central R. R. of Georgia.—It has been decided to extend the Mobile & Girard R. R. from its present terminus at Troy, Ala., to a connection with the Louisville & Nashville R. R., at Brewton or Pollard, Ala. The road will be bonded to the amount of $12,750 per mile to secure the necessary money for construction.

Cincinnati, Georgia & Florida.—F. A. Vaughan, of Graysville, Ga., President, writes us as follows:

This is an old road, which was partly graded before the war, under the name of the Tennessee, Chattooga & Coosee River R. R. It is projected to run from Harrison, Tenn., about 18 miles northeast of Chattanooga, Tenn., via Tyners, Tenn., and Graysville, Ga., to Kensington, Ga., a distance of 50 miles. The present company was chartered about five years ago, but an organization was not perfected until about 18 months ago. Nothing has been done toward the construction and completion of the road except making a new survey and clearing the right of way. The route of the road is through a rich mineral and timber section, and crosses several existing lines of railway. The work of construction will be generally easy, there being no tunnels and only a few bridges. The company needs more capital in order to proceed with the work, and efforts are now being made to interest capitalists in the enterprise.

Tennessee & Coosa.—Hunter McDonald, of Huntsville, Ala., Chief Engineer, writes as follows:

The contractors, Allison, Shafer & Co., of Chattanooga, Tenn., have a force of about 600 men at work on the extension from Littleton to Guntersville, Ala., 75.78 miles. The section south of the Tennessee River, and for 5 miles along the east side after crossing is heavy work; maximum grade 120 ft. per mile, and maximum curve 6°. The remainder of the work is quite light. There will be a bridge over the Tennessee River. It is expected to have the first 19 miles south of Littleton completed by Jan. 1. The entire line has been located, but it is possible that the route may be changed. The route from Guntersville north has not been decided upon. One mile of track has already been laid, and it is expected to have the 23 miles now under construction in operation by March or April 1891.

South Bound.—About 40 miles of the grading from Savannah, Ga., north have have been completed, and five miles of track laid; track is now being laid at the rate of 5 miles per day.

Norfolk & Western.—The Clinch Valley division of this railway is rapidly nearing completion. Contractor Geo. T. Mills has completed his contract, which comprised 30 miles of work. Sexton & Houston are the remaining contractors, and are at present grading the large yard at Norton, which is to be jointly used by the Norfolk & Western and the Louisville & Nashville railways. Track is now laid through Little Tom Tunnel to Guests station, 89 miles from Graham Junction. Eleven miles yet remain to be laid before Norton is reached. Track is being laid at the rate of a mile a day, which will complete this division before Christmas.

Projects and Surveys.

Georgia, Tennessee & Illinois.—R. T. Macdonald, C. E., of Tallapoosa, Ga., writes us that he is Chief Engineer of this railway instead of L. F. Bullinger, as noted in our issue of last week.

Tennessee.—A mass-meeting of the citizens of Stewart County has been called to meet at Dover, Monday, Dec. 8, for the purpose of taking action to secure a railway through that county. It is understood that the Cumberland Iron Co. will give a large sum toward the construction of the road. This company has recently invested largely in mineral lands around Dover, Tenn., and will erect an iron furnace soon. The Cumberland River is the only means of transportation at present.

Thomasville Southern.—Right of way is being secured from Thomasville, Ga., south to the Florida State line, and work it is reported will soon be commenced. The road will run when completed from Thomasville, Ga., to Tallahasee, Fla., the Tallahassee Northern R. R. Co. having been chartered to build the Florida division.

Carolina, Greenville & Northern.—Jonathan Bullard, Chief Engineer, will soon begin surveys between Paint Rock and Kingsport, Tenn.

Linville Improvement Co.—This company has just completed the location of its line from Linville to Blowing Rock, N. C.

Camden, Chester & Gaffney City.—Engineers are now locating this road from Camden, S. C., to Asheville, N. C., and it is announced that contracts will be let about Jan. 1.

Georgia.—A bill has been introduced in the Georgia State Legislature to charter the Atlanta, Americus & Florida R. R. Co., to build a railway from Atlanta, Ga., to Tampa, Fla. Bills have also been introduced incorporating the Washington & Middleton R. R. Co., and the Richlands, Gulf & Northern Ry. Co.

Montgomery, Hagerville & Camden.—This company has petitioned the Alabama Legislature for a charter to construct a railway in the counties of Montgomery, Lowndes and Wilcox.

Louisville Southeastern.—It is announced that surveyors will soon be put in the field by this company to locate its lines from Louisville, Ky. to Jeffersontown Ky. Judge W. B. Hoke of Louisville, Ky., is President.

Mobile Western.—This company has been chartered in Alabama, by John H. Turner, Mobile, Ala., H. Merigold Lima, Ohio, D. H. Campbell, Anniston, Ala., and others. The company has purchased 20 miles of graded roadbed of the old Mobile & Northwestern R. R. and proposes to rebuild the road and extend it to Jackson, Miss. The same men have chartered a construction company to carry on the work.

NORTHWEST.—Existing Roads.

Duluth, Pierre & Black Hills.—B. P. Tilden, of Aberdeen, S. Dak., chief engineer, writes as follows:

About 45 men and 250 teams are now at work on this road. The route is from Oakes, Dickey Co., N. Dak., via Aberdeen, to Pierre, S. Dak., 181½ miles, of which 15.8 miles are in North Dakota, and 165.5 miles are in South Dakota. The line is through a rolling prairie country, affording easy work; maximum grade 40 ft. per mile, and maximum curve 4°. The right of way has been secured between Aberdeen and Faulkton, 45 miles, and $250,000 have been obtained from the cities of Pierre, Aberdeen and Faulkton. The entire line has been located with the exception of some minor details. It is expected to commence tracklaying about June 1, 1891, and to have the road completed by Nov. 1, 1891.

Port Arthur, Duluth & Western.—About 250 men are now at work, and it is expected to complete 50 miles of the line before Jan. 1. The company is using 56-lb. steel rails. During the winter work will be continued clearing the right of way on the remaining 35 miles to the boundary, and building the bridges and masonry. The average cost of construction is $10,000 per mile, and the company receives bonuses amounting to $6,700 per mile. It is expected that an extension of the Duluth & Iron Range R. R. will be built to connect with this line during the coming summer.

Duluth & Southern.—In a recent newspaper interview H. B. Wamsley, one of the Directors of the Duluth & Southern Railroad said:

"Negotiations are pending for a coalition of the Soo Line and Duluth & Southern. The Soo people desire to get into Duluth, and for this purpose will probably

use the Red Wing Road. The arrangement is more than a traffic agreement, for the Soo intends to run its own trains over the line into Duluth, while the Duluth & Southern Co. will use the line from Duluth to Red Wing and south to Iowa. The Southern Road people will also be enabled to enter St. Paul by using the Soo. Not only will the Soo enter Duluth over our line, but the Duluth, South Shore & Atlantic will come in with the Soo. Conferences between the South Shore people and ourselves looking to this end have already taken place."

Burlington, Cedar Rapids & Northern.—The line from Troskey to the quarries north of Jasper, Minn., 13 miles, has been completed.

Winona & Southwestern.—It is stated that this company has purchased the Mason City & Fort Dodge R. R., and will improve it by building new bridges, etc. On Jan. 1 the engineering corps will commence the location of the line from Fort Dodge, Ia., to Omaha, Neb.

Davenport, Iowa & Dakota.—The Burlington, Cedar Rapids & Northern R. R. Co. has obtained possession of the Davenport, Iowa & Dakota Ry., now completed about 30 miles out of Davenport. The road will be built to the point of intersection with the Clinton branch of the Burlington, Cedar Rapids & Northern, near Tipton, but it will not be extended farther. The surveys have been made as far as the north part of the State.

Chicago, Rock Island & Pacific.—The extension from Omaha to Lincoln, Neb., has been completed.

Projects and Surveys.

Winnipeg & North Pacific.—Surveys for the first 50 miles of this road from Winnipeg, Man., northwest have been commenced by A. J. Belcher, of Toronto, Ont. This company was chartered in 1886 to build a railway from Winnipeg, Man., to Fort Simpson, at the mouth of the Skeena River, on the Pacific coast.

Wisconsin Bee Line & West Superior.—Chas. D. Smith, of Fond du Lac, Wis., President, writes that this road is to run from Milwaukee to Lake Superior, Wis., 360 miles. The line is through a level country, and will be easy to construct. Contracts will be let some time during the summer of 1891.

Ontario & Rainy River.—This railway is to run from a point on the Port Arthur, Duluth & Western R. R., about 20 miles north of the International line, to the northwest angle of the Lake of the Woods, a distance of 180 miles. Work will begin next summer, and be completed as soon as possible.

SOUTHWEST. Existing Roads.

St. Louis, Chester & Grand Tower.—The contract for building this railway has been let to Shafer, Neir & Co., of St. Louis, Mo., and work will be pushed. S. Dwight Eaton, St. Louis, Mo., is President and Chief Engineer.

Kansas City, Ft. Smith & Southern.—This road will be completed from Kansas City to Amoret, Mo., this season. During the coming year the line will be extended to Joplin.

Haines, Hamilton & Kingston.—This road has been completed from Hamilton to Kingston, Mo., 8 miles.

Waco, Lampasas & Llano.—The contract for building this Texas road has been let to the Llano Construction Co., to be completed Oct. 1., 1891. Grading is now in progress.

Southern Pacific.—A cut-off of 7 miles has been surveyed from Shumler to Flanders, Tex., and work will be commenced at once. Through this cut-off the road will avoid one of its most dangerous points, and will abandon 2 tunnels and 26 bridges, which in building cost more than $4,000,000. The Pecos River will have to be bridged, necessitating spans stretching 1,200 ft., and more than 300 ft. above the river bed. The cost of this work will be about $1,000,000, and the contractors have guaranteed to have the work completed within 9 months.

Projects and Surveys.

Lampasas, Burnet & Southwestern.—A correspondent writes us that nothing is being done on this enterprise at present. The road is projected to run from Lampasas to Burnet, Tex., 25 miles. One preliminary survey has been made. The work will be generally light. J. H. Galbraith is President.

Gainesville, Oklahoma & Gulf.—Chartered in Texas to build a railway from Gainesville, Tex., northwest to the Red River. Surveys will begin at once.

Gainesville, McAlister & St. Louis.—Chartered in Texas to build a railway from Gainesville, Tex., northeast to the Red River. Surveys will begin at once.

Beaumont & Bolivar.—Mark Weiss, of Beaumont, Tex., can give information in regard to this railway.

Hempstead & Brazos City.—Books have been opened for subscriptions to the stock of this Texas company.

Georgetown & Grainger.—Surveys are in progress for a railway from Georgetown to Grainger, Tex., under the direction of John O'Neil, Bullinger, Tex. Emsy Taylor of Georgetown is president.

Sabine Pass.—A report is in circulation that this road from Marshall, Tex., south, will be built soon.

Eagle Pass & Gulf.—At a recent meeting of the Board of Trade arrangements were made to secure the survey of a railway from Eagle Pass, Tex., to the Gulf of Mexico.

ROCKY MT. AND PACIFIC.—Existing Roads.

Great Northern.—Shepard, Seims & Co., 32 National German Bank Building, St. Paul, Minn., are prepared to receive bids for a large amount of work west of the summit of the Rocky Mountains on the line of the Great Northern R. R., including grading, which consists of rock, earth work and tunneling and a large amount of timber; also a large amount of hewn timber for structures. The work is located and the supplies for carrying it on are on the ground and the work is ready to commence at once.

Oregon Improvement Co.—This company has completed 36 miles of track on the Seattle & Northern R. R. and 20.2 miles on the Port Townsend Southern R.R. since Jan. 1, 1890.

Southern Pacific.—It is probable that this company will build a line from a point in the Capay Valley through Cache Creek Cañon to Lower Lake and Lakeport, Cal.

Projects and Surveys.

Utah Midland.—At a recent meeting of the stockholders the following officers were elected: President, J. J. Hagerman; Vice-President, W. S. McCornick; Secretary, C. E. Noble, and Treasurer, H. T. Rogers. This road is the proposed continuation of the Colorado Midland R. R. in Utah.

Hailey, Gold Belt & Western.—A second survey is being made for this railway from Hailey, Idaho, west.

CITY TRANSIT.

Cable Railways.—*Washington, D. C.*—Surveys are now being made for the Washington & Georgetown cable lines. The present plans call for a 6½-mile cable, 3,000 tons of 80-lb. rails, a large amount of 63-lb. slot rails, 2,500 tons of special castings for yokes, covers and other parts, 25,000 bbls. Portland cement, 20,000 cu. yds. broken stone and a large quantity of other material. The consulting engineer is Daniel Bontecou. The total cost of the plant is now estimated at $3,000,000.

Dummy Railways.—*Montpelier, Vt.*—The Montpelier & Wells River R. R. has decided to build a dummy line to Barre.

Oxford, Ala.—The Oxford Lake Line will probably issue $75,000 of bonds to improve its track and rolling stock.

Salt Lake City, Utah.—Construction on the Great Salt Lake & Hot Springs Ry. will probably begin at once. The line will be 20 miles long. H. Ramel has charge of the construction and H. S. Joseph is consulting engineer.

Horse Railways.—New companies or extensions are proposed at Toronto, Ont., by the Weston, Hyde Park & Toronto Street R. R.; Norfolk, Va., by the Norfolk & Eastern Investment Co.; Charlestown, W. Va., by the Charlestown Construction Co.; Ocala, Fla., by the Ocala Street & Suburban Ry.; Mt. Vernon, Ind.; Corpus Christi, Tex., by the City Street Ry.

Owensboro, Ky.—The entire street car equipment in this town was destroyed by fire on Nov. 25. The loss is estimated at $60,000.

New Brighton, Ill.—J. T. McCasland recently received a franchise for constructing a street railway in this village. Rails and ties have been already ordered.

Austin, Tex.—The City Council has granted E. J. Heppenheimer and associates franchise to construct a street railway, and J. J. and W. H. Tobin have applied to that body for a similar franchise.

Electric Railways.—*Rockland, Me.*—Surveyors have recently located an electric line to Thomaston. Construction will probably begin in the spring.

Pawtucket, R. I.—The Interstate Ry. has received permission to lay tracks in this city. The headquarters of this company are in Attleboro, Mass.; the President is H. M. Daggett.

Bridgeport, Conn.—The Bridgeport Horse Ry. has been sold to the syndicate of Rochester, N. Y., parties which owns the street railway lines in Rochester, Buffalo, Paterson and Newark. It is reported that the purchasers will extend the lines and electricity will probably be adopted.

Erie, Pa.—G. Gelden and W. White, of this city, have recently been inspecting the electric railways of Pittsburg with a view to adopting electricity on the lines here.

Cumberland, Md.—The Cumberland Electric Ry. has completed its organization by electing L. Fletcher as President, G. Landwehr as Secretary and Treasurer, and D. J. Duncan as Superintendent. The contract for the plant is reported to have been given to the Electric Equipment Co., of Pittsburg.

Richmond, Va.—A petition has been filed with the city authorities by J. W. Laube, M. B. Leonard and associates for right to build and operate a storage battery line on several streets.

East Chattanooga, Tenn.—The East Chattanooga Land Co. will, it is said, probably construct an electric railway.

Raleigh, N. C.—Dr. Jacobs, of Chicago, owner of the street car system here, is said to have decided to operate 10 miles of his lines with the Sprague motor.

Atlanta, Ga.—F. Carter, 12½ East Alabama St., wants estimates for the construction and equipment of 6 or 7 miles of electric railway.

Sheffield, Ala.—The Sheffield Street Ry. Co. is reported about to change its dummy line to an electrical railroad.

Gadsden, Ala.—The Land & Improvement Co. of this town proposes changing its 8-mile dummy line into an electric railway.

Memphis, Tenn.—C. B. Holmes, the head of the syndicate which recently purchased the street car lines in this city, has made an agreement with the city council by which the city recognized the consolidation of the two street car companies bought out by the syndicate, and gives it an exclusive right to run cars on the streets where tracks are already laid until the year 1916. In return the syndicate agrees to lay $150,000 worth of paving and to substitute electricity for mules as motive power.

La Porte, Ind.—Snow & Avery, Detroit, Mich., have received a franchise for constructing an electric railway in this city. The motive power will probably be furnished by the local lighting company.

River Forest, Ill.—The Cicero & Proviso Street Ry. contemplates an extension of its system.

Champaign, Ill.—The Champaign & Urbana Street Ry. has received permission to use electricity on its Urbana line, and the track is now being put in condition.

Pine Bluff, Ark.—It is stated that New York parties are endeavoring to buy the railways here for the purpose of changing them into electric lines.

San Bernardino, Cal.—An electric railway to Arrowhead is reported as probable. The power station will presumably be located in a cañon in this neighborhood, where large water power is available.

New Companies.—Blue Island & Harvey Street Ry., Blue Island, Ill., capital stock, $250,000; incorporators, J. McConnell, E. H. Rexford, A. Rainer. People's Street Car Co., Racine, Wis., capital stock, $150,000; incorporators, F. K. Bull, W. B. Dutton, B. B. Blake. Love Electric Traction Co., Chicago, Ill., capital stock, $10,000,000; incorporators, J. C. Love, H. N. Hibbard, A. G. Wheeler. Huntington, W. Va., Belt Line, capital stock, $20,000; incorporators, C L. Hafner, J. A. Toben, R. A. Goodwin and others.

HIGHWAYS.

Rhode Island.—Macadamizing is progressing in districts Nos. 8 and 9, near Providence. The Highway Surveyor of these districts in his report states that the work is somewhat handicapped by the department not being supplied with a suitable watering cart, without which good work cannot be done. It could also be used to sprinkle the streets during the summer months, thereby doing away with the individual assessments for this work, and keeping the highways in a better condition.

Washington.—The County Commissioners, at a meeting at Port Angeles in November, passed an order to submit a proposition to issue bonds for $100,000 for county roads. It is proposed to divide the county into 3 districts, the amounts for each being $25,000, $35,000 and $40,000.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Cincinnati, O.*—Contracts are to be let for constructing a bridge for the Middletown & Cincinnati R. R. over the Lima River. M. D. Burke, C. E., Room 41, Pike Building, Cincinnati, O., Chief Engineer.

Covington, Ky.—A stock company will probably be organized to build a bridge over the Licking River at Tenth street.

Quiro, Wis.—A small iron bridge is to be constructed. Estimated cost, $4,500.

Sheboygan, Wis.—The Board of Public Works invites plans and specifications for an iron swing bridge over the Sheboygan River at Eighth street to replace the one now in use. Address, C. U. Boley, City Engineer, Sheboygan, Wis.

Omaha, Neb.—The East Omaha Land Co., in which the banking firm of Drexel, Morgan & Co. has a large interest, accepted plans, Nov. 29, for a new railway and wagon bridge across the Missouri River at this point to cost $1,500,000.

WATER-WORKS.

NEW ENGLAND.

Rochester, Vt.—The bill incorporating the Rochester Water Supply Co. has been signed by the governor.

Lowell, Mass.—Proposals for a 10,000,000-gall. pumping engine will be received by the Water Board, committee on new engine, until Jan. 16. See our "proposals" columns.

Needham, Mass.—The new town works have just been put in operation and tested. Cost, about $75,000.

MIDDLE.

Whitestone, N. Y.—The following is from C. B. Williams, Secretary Board of Water Commissioners:

Bonds for the introduction of water have been voted. The village will probably lay its own pipes and buy water from the Flushing, College Point or Central Forge works.

Collingswood, N. J.—The following is from G. Frank Davis:

The Collingswood Water & Light Co. propose to complete works by April 1, 1891. The supply will be pumped from an artesian well to a tank or stand-pipe. The company is not yet fully organized. Estimated cost, $10,000. Population 800 to 1,000.

Pottstown, Pa.—Improvements costing about $20,000, consisting of a 5,000,000-gall. reservoir, a 24-in. force and 20-in. supply main are now being made by the Pottstown Water Co.

Washington, D. C.—The estimates for the next fiscal year, as given in the annual report of the water department for the year ending June 30, 1890, include the laying of two mains of considerable size, one in the northeastern the other in the southwestern part of the city.

SOUTHERN.

Sumter, S. C.—It is reported that a tank will be built.

Bunkley, Ga.—It is reported that the Cumberland Island Co. will build works on Cumberland Island.

Columbus, Ga.—The plant of the Columbus Water Works Co. may be sold to a syndicate.

Milledgeville, Ga.—Dec. 9 a vote will be taken on an increase of the rate of taxation for the purpose of raising money to rent hydrants from a prospective water company. Address G. W. Coraker, City Clerk.

Valdosta, Ga.—A Chattanooga firm has made a proposition to put in works. If the council rejects it the town may sink an experimental artesian well.

Riverside, Fla. (***Jacksonville P. O.***)—The Riverside Artesian Well Co. are trying to secure aid from the city in placing a few hydrants.

Bridgeport, Ala.—It is reported that $65,000 works will be built.

Sheffield, Ala.—The city will apply to the legislature for authority to issue $150,000 of water-works bonds. Messrs. Johnson & Flad, St. Louis, Mo., were employed last summer to report on works. Works were recently completed by the Sheffield Water Co.

Cleveland, Tenn.—Address J. L. Young regarding contract for works to supply 5,000 people.

Knoxville, Tenn.—Important extensions, it is reported, are under consideration by the Knoxville Water Co., including the moving of the pumping station further up the river, new pumps and mains and a new reservoir.

Harrodsburg, Ky.—Bids for the construction of works are wanted by W. K. Cardwell, Mayor.

NORTH CENTRAL.

Cincinnati, O.—Bids will be received until Dec. 26 for four 5,000,000-gall. vertical pumps, as specified in our "proposals" column.

Franklin, Ind.—The following is from the Boughen Engineering Co., Cincinnati, O.:

The Franklin Water, Light & Power Co. will immediately begin the construction of works estimated to cost $100,000. J. J. Hainsworth, Franklin, is Vice-President and Engineer. The supply will be from driven wells, probably by direct pumping. The contracts will be let soon. Population, 4,000.

Lebanon, Ind.—The citizens have voted to construct works. The City Council now has ways and means under consideration. For further information address C. F. S. Neal, C. E.

Alpena, Mich.—W. H. Johnson, Superintendent, has sent the following:

The Alpena City Water Co. has purchased a water power privilege about 1¼ miles from its present pumping station and proposes to use it to run its pumps either by water power or by transmitted electricity.

Kalkaskia, Mich.—The following is from M. Walker, Fenton, engineer and contractor:

Works to be owned by the village will be completed about Jan. 1. The supply is by direct pumping from a river, and there are 3 miles of mains. Cost, about $25,000.

Belleville, Ill.—A new company is projected to introduce a daily supply of 3,000,000 galls., from wells, Pittsburg Lake or the Mississippi River. A large reservoir is included in case the supply is from the latter source.

Chicago, Ill.—The water supply of a part of that section of the city formerly the town of Lake has been increased by connecting the distribution with larger supply mains, recently completed from the Sixty-eighth street pumping station west for some distance.

Du Quoin, Ill.—It is reported that the search for a water supply, previously mentioned, has been successful, a plentiful supply having been struck about 1¼ miles from town.

River Forest, Ill.—The proposition of the River Forest Water & Electric Light Co. regarding both water-works and electric lights has been referred by the village board to a special committee, consisting of A. J. Cost, President of the village board; F. J. Triffin, village attorney, and others.

NORTHWESTERN.

Avoca, Ia.—It is reported that the sum of $10,000 has been voted for works.

Davenport, Ia.—A contract for a 6,000,000-gall. filtering plant has been awarded the American Filter Co., of Chicago. The contract specifies that the plant must be in operation April 1. The Davenport Water Co. will issue $300,000 of additional bonds, it is reported.

Leeds, Ia.—D. Ede informs us that there has been talk of obtaining a water supply from Sioux City.

Orange City, Ia.—Preparations are being made for constructing works.

Abilene, Kan.—A ditch 4 miles long is being constructed to bring water from Sand Springs.

Liberty, Neb.—E. E. Hunter informs us that works to cost about $1,500 will be contracted for this month.

Canton, S. Dak.—The following is from A. A. Richardson, Engineer, Lincoln, Neb.:

Contracts were to be let Dec. 1 by the town for works estimated to cost $21,000. Water will be pumped from an open well near Big Stone River to a 12 × 100-ft. standpipe. J. M. Green is Mayor. Population, 2,000.

Butte, Mont.—Two companies are planning to build works in addition to those already supplying the town. It is stated that the first company proposes to expend $2,000,000 and to construct two reservoirs, with a combined capacity of 500,000,000 galls., on the summit of the divide 25 miles west of the city. From these reservoirs it is proposed to lay a 30-in. main to a reservoir to be constructed back of the city. The other company, called the Anaconda, has secured water rights in Elk Park. Their scheme includes a tunnel through a mountain, and they have already purchased an abandoned mining tunnel extending part of the distance. A distributing reservoir, to be built near the Anaconda mines, would serve both the mines and the city. The cost of these works is estimated at $1,200,000.

SOUTHWESTERN.

Batesville, Ark.—The Batesville Water & Light Co. has filed incorporation papers, with Samuel B. Hartz, President. J. W. King and I. N. Reed are among the other incorporators. Authorized capital stock, $100,000.

Arlington Heights, Tex. (***Fort Worth, P. O.***)—H. W. Tallant, Assistant-Secretary, has sent the following:

The Chamberlain Investment Co. began to operate their works Dec. 1. The supply is pumped from artesian wells to a tank by two Cook pumps. There are 3¼ miles of mains.

Galveston, Tex.—A committee has revised the city charter, so that, if the revision is adopted, an additional $500,000 can be spent for water-works.

Llano, Tex.—M. L. Lynch, Ft. Worth, it is reported, is preparing plans for works.

Antoinette, Col.—S. W. Hatch has sent the following:

The village proposes to let contracts for works next spring. The supply will be pumped from Conjos River to a tank. Estimated cost, $6,000. The present supply is hauled from the river in barrels. John J. Corlett can give further information. Population, 500.

Denver, Col.—It is reported that the Denver City Water-Works Co., reported last week, is a consolidation of the Denver Water Co., which built works in 1871-2 and the Beaver Brook and Mountain Water Cos. The Beaver Brook Water Co. built works in 1887 to supply Highlands, a town adjoining Denver. Recently the Mountain Water Co. began the construction of works to bring a gravity supply to Denver, Barnum, a suburb of Denver, and to supply water to the Beaver Brook Water Co. The officers of the new company are stated to be: president, W. P. Robinson; vice-president, J. H. Pullen; secretary, M. A. Wheeler; treasurer, C. B. Rhodes.

Trinidad, Col.—Bids will be received at the City Clerk's office until December for the construction of a 71,000,000-gall. storage reservoir for the city water-works. Address Norval W. Wall, City Engineer, or Everett Bell, City Clerk.

PACIFIC.

North Yakima, Wash.—The works have been completed and tested.

Puyallup, Wash.—It is reported that the Puyallup Water Co. is building another reservoir.

Sacramento, Cal.—A new 10,000,000-gall. pump has been recommended by a board of experts, which recently examined the city's pumping plant.

Salt Lake City.—The mains will be extended on two streets.

CANADA.

New Westminster, B. C.—Contracts for furnishing cast-iron pipe, castings, lead, hydrants and valves were let by the city some time since.

IRRIGATION.

Inyo Co., Cal.—The Queens River & Salt Wells Valley Canal has been partially surveyed in this county. It is stated that the canal will be 60 ft. wide, 8 ft. deep and 51 miles long, and that a navigation line will be maintained; also that a large storage reservoir will be built at Little Lake and other reservoirs elsewhere.

Perris, Cal.—A vote has been taken in favor of issuing bonds to bring water from the Bear Valley reservoir for irrigating purposes.

Boise City, Ida.—Work is in progress about 10 miles from this city on the New York canal, which is being built by the Idaho Mining & Irrigation Co. W. C. Bradbury is Contractor. The canal will be 81 ft. wide at the top, 45 at the bottom, 12 ft. deep and about 90 miles long, not including laterals. The headworks are of masonry in Portland cement.

SEWERAGE AND MUNICIPAL.

Sewers.—***Quincy, Mass.***—The City Council has adopted the report presented by the Sewer Committee.

Waltham, Mass.—The city has adopted a report of the Sewer Commissioners, providing for an appropriation of $300,000 for the completion of the sewer system.

Belfast, Me.—Plans for a complete system of sewers have been prepared by Wheeler & Parks, of Boston, Mass. The cost is estimated at between $45,000 and $50,000. The city has completed a small part of the proposed system, having laid an 8-in. tile pipe through a part of Main St., at a cost of some $2,500, the work being done by the city direct and not by contract. Probably $3,000 or more will be expended in building sewers during 1891.

Washington, D. C.—Supt. McComb, of the sewer division, has presented his annual report. There are still a number of defective pipe sewers which were built before 1874. An appropriation of $35,000 for the construction of sewers under the permit and compulsory permit system is recommended for 1891.

Columbia, S. C.—A sewerage commission composed of Aldermen Dunn, Sloan and Brennen has been appointed to have surveys and estimates made for a system of sewers.

Knoxville, Tenn.—The plans prepared by Col. Hartford, of Chattanooga, and approved by Mr. Nicholson, the City Engineer, provide for a sewerage system to cost about $244,000. The system includes West and North Knoxville and Elmwood, and the part for the city will cost $175,000.

Mobile, Ala.—The Council has adopted the report of the Committee on Sewerage and Paving of the city. It provides that when more than half the property owners on any street agree that sewerage or paving is necessary the city may proceed to pave and lay sewerage pipes and charge each their proportion of the expense. Should the parties fail to pay their property is to be held liable. Accompanying the report is a bill to be presented to the legislature at its present term.

Columbus, O.—Ordinances have been passed providing for the issue of $20,000 in bonds for main trunk sewers on Wall and Third Sts.

Oak Park, Ill.—The Drainage Committee of the Town Board will confer with the Chicago Drainage Committee in regard to Cicero sewers and the future main outlet.

Galveston, Tex.—The city will spend about $500,000 on sewer work.

Sault Ste. Marie, Mich.—The sewer work for the next season will probably be limited to the construction of about 1,200 ft. of sewers with 3 manholes.

Bucyrus, O.—About 1 mile of sewer extension will be built next season; it will be of egg-shape pipe, from 12 to 20 ins. diam. The Star sewer drop will be used, with 9 × 12-in. P traps; manholes furnished with iron ventilating covers. About 100 of these inlets are in use and are found a success.

Sheffield, Ala.—Contracts are reported to have been let for the construction of a system of sewerage.

Birmingham, Ala.—The city will apply to the Legislature for authority to issue bonds for $150,000 for sewers and street work.

Wilmington, N. C.—An ordinance has been adopted providing that no sewers must be laid without the consent of the Board of Aldermen, and in conformity with sanitary regulations; the work to be under the direction of the City Surveyor.

Chicago, Ill.—The drainage trustees have directed their engineer, Mr. Cooley, to suspend work upon the upper Desplaines River and below Joliet, to make additional surveys between Chicago and Summit, and to prepare his field notes so as to locate not less than one of the four routes for the main channel between Chicago and Summit.

Woonsocket, R. I.—Mr. John W. Ellis, C. E., writes us that the question of sewers is now being agitated, as they are a public necessity.

Streets.—***Boston, Mass.***—The Street Commissioners have submitted a plan for laying out new streets in the district bounded by Columbus Ave., Park Sq., Boylston, Berkeley and Tremont Sts.

Allegheny, Pa.—Ordinances have been passed authorizing the regrading and repaving of Rebecca and Federal Sts. Asphalt, asphalt block, Belgian block, granite block or ligonier paving may be used.

Austin, Ill.—Cedar block paving is being laid on Park Ave.; the paving is to be continued to Chicago Ave.; it will be 30 ft. wide, with stone curbing.

Savannah, Ga.—The improvement committee will ask for an appropriation of $60,000 for street work during 1891.

St. Louis, Mo.—A new kind of paving brick has been submitted to the Street Commissioner. The present commissioner is in favor of gum blocks, with granitoid sidewalks.

Alexandria, Va.—A systematic method of street improvement is projected to do away with the old cobblestone paving. Work would be commenced in the spring.

Pittsburg, Pa.—The Department of Public Works will not let any more street contracts this year, and has rejected a number of bids for street work. The reason is that the season is so far advanced, and so much work is already under contract.

Galveston, Tex.—The improvement committee has provided for an expenditure of $500,000 on streets next year.

Bucyrus, O.—The city is building about 2½ miles of brick streets.

Indianapolis, Ind.—A considerable amount of asphalt paving is to be done next season. Some contracts have already been awarded to the Warren-Scharf Asphalt Paving Co., of New York, and others are to be let.

Gas.—***San Diego, Cal.***—The San Diego Gas & Electric Light Co. has a contract to furnish gas to the county for 2 years at $2.75 per 1,000 cu. ft.

Drainage.—A company has been formed to reclaim a large tract of waste land near Muscatine, Ia., stretching from Drury's landing to New Boston. It is proposed to build a protecting levee and drain the ground, at a cost of $75,000. The tract is from 20 to 25 miles long, and stretches from the Mississippi to the bluffs, an average distance of 2 miles, comprising an area of 10,000 acres.

ELECTRICAL.

Electric Light.—New plants or extensions of existing systems are proposed at Shamokin, Pa.; Morganton, N. C., address the Deuravant Cotton Mfg. Co.; Dawson, Ga. Savannah, Ga., address the Brush Electric Light & Power Co.; Alexandria, La.; Memphis, Tenn., address the Empire Elevator, Mill & Warehouse Co.; Nashville, Tenn.

address the Nashville Chattanooga & St. Louis R. R.; Newport, Tenn., address the Newport Electric Light & Power Co.; Henderson, Ky., address the Mayor; La Porte, Ind.; Du Quoin and Aledo, Ill.; Elgin, Ill., address Fay & Gerlach; New London, Wis.; Fort Worth, Tex., address the Fort Worth Electric Light & Power Co.; Mexia, Tex., address the Mayor; Essex, Nev., address the Inyo Marble Works.

Waterville, Me.—The Waterville Electric Light Co. has purchased water power in the neighborhood, and will put in additional machinery for lighting and power.

Jamestown, N. Y.—The town has bought a site for the proposed electric light station, and will at once erect a building for the plant, specifications for which call for a capacity of 175 arc lamps of 2,000 c. p. The total amount of wiring necessary has been estimated at 24 miles.

Washington, D. C.—The electric street lamps in this city have been entirely maintained by underground wires since September, 1889. The interruptions have been somewhat more frequent than when the overhead system was used, but the experiment has been satisfactory. About 195 lamps of 1,000 c. p. are used. The prices paid during the last year were at the rate of 60 cts. a night. The type of conduit used is the square terra cotta pipe, containing from 2 to 6 cells.

Wheeling, W. Va.—In the new plant of the Wheeling Electric Co., special provision has been made to do away with the annoyance caused by the vibration of the machinery. The base of the power room consists of one large mass of concrete, 30 ins. thick. The foundations for the different machines are all built into this concrete, and the connection thus formed will, it is hoped, produce an unusually firm structure.

Point Pleasant, W. Va.—D. S. Snyder wishes prices for an incandescent electric light plant.

Northport, Ala.—The city will, it is stated, petition the legislature for authority to issue bonds to secure the erection of an electric light plant and the construction of water-works.

Sumter, S. C.—The Sumter Electric Light Co. contemplates purchasing a 500-light incandescent dynamo.

Chattanooga, Tenn.—It is reported that the Thomson-Houston Electric Co., Boston, Mass., has purchased land for a power station, and will soon build a 150 × 200 ft. dynamo and engine house.

Centralia, Ill.—T. J. Wilson, S. L. Dwight, J. J. Wetmore and J. Benson have secured a 10 year franchise for an electric light and power plant in that city.

Manistee, Mich.—An electric light company was recently organized here with G. A. Hart, as President and L. E. Morris as Secretary.

Davenport, Ia.—All bids for electric street lighting recently received have been rejected and the lighting committee has been directed to advertise again. The contract calls for 100 arc lights of 2,000 c. p.., and 300 incandescent lamps of 32 c. p. with the privilege of more of either kind at the respective price of the bid for each; the bids to be for 3, 5 and 7 years.

New Companies.—Monticello, Mo, Electric Light Co.; capital stock, $25,000; Greenville, Ill., Electric Light & Power Co., capital stock, $10,000; incorporators, C. D. Hollis, W. V. Weise, V. Harrold. Abilene, Tex., Electric Co.; incorporators, M. Elser, J. W. Watkins, P. M. Devitt, W. H. Edrington. McFell Electric Co., Chicago, Ill.; capital stock, $8,000; incorporators, J. McFell, F. W. Watts, W. J. McWade. Cannon City, Colo., Electric Light & Power Co.: capital stock, $30,000; incorporators, J. H. Peabody, W. T. Bridwell, C. C. Yikirk, H. B. Slater. Crisfield, Md., Electric Light Co.; L. E. P. Dennis, secretary; capital stock, $10,000. Morgan Park Electric Co., Chicago, Ill.; capital stock, $25,000; incorporators, G. S. Wheaton, G. A. Meech, J. H. Westover. Macrae Electric Co., Baltimore, Md.; capital stock, $20,000; incorporators, W. W. Donaldson, R. Macrae, A. H. Robertson.

CONTRACTING.

Piles.—*New York, N. Y.*—The Department of Docks has awarded a contract to Beard & Kempland, for piles 60 to 65 ft. long, at $8 each, and to A. J. Murray, at $5, $6 and $6.50 each, for piles 50 to 55 ft., 55 to 60 ft. and 60 to 65 ft. long respectively.

Levee.—The County Commissioners, Cincinnati, O., have received bids for 25,000 cu. yds. of levee at the Calloway suspension bridge, in Whitewater township; the prices ranged from 16½ to 21½ cts. per cu. yd.

Sewers.—*Detroit, Mich.*—The following were the lowest bids received recently by the Board of Public Works: Baker St., 2,938 ft. of sewer and 5 manholes; John Affeld, $4.39 per lin. ft., and $30 per manhole. Wabash Ave., 2,565 ft. and 5 manholes, F. Porath, $3.85, $40. Eighteenth St., 2,184 ft. and 4 manholes; F. Porath, $3.12, $45. McDougall Ave., section 1, 1,703 ft. and 3 manholes; W. H. Henderson, $4 and $25. Campau Ave., 1,875 ft. and 3 manholes; W. H. Henderson, $2.89, $25. McDougall Ave., section 2, 1,886 ft. and 3 manholes; Langley & Jaynes, $4.19 per ft. and $40.

Brooklyn, N. Y.—The Department of City Works has received the following bids for sewer work: Harris & Maguire; 18, 15 and 12-in. cement pipe, $1.95, $1.75 and $1.23 per ft.; manholes, $33 each; street basins, $98 each. James F. Gillen; $1.75, $1.75 and $1.25 per ft. for pipe, $35 for manholes, $100 for basins.

Street Work.—*Buffalo, N. Y.*—The bidders for asphalt paving on Genesee St. were the Barber Asphalt Paving Co., German Rock Asphalt Co., and the Buffalo Paving Co. The latter made the lowest bids, but they were declared informal, as they proposed to use American bituminous rock, while the specifications call for Trinidad asphalt. The alternative bids of the German Rock Co., for Sicilian asphalt, were also informal.

PROPOSALS OPEN.

Railway.—Grading, rock work, tunneling and timber work on the Rocky Mountain division of the Great Northern Ry. Shepard, Siems & Co., 32 National German-American Bank Building, St. Paul, Minn.

Station.—*Terre Haute, Ind.*—Passenger station. Architects, Hannaford & Sons, Cincinnati, O. George E. Farrington, Secretary, Terre Haute & Indianapolis Ry. Dec. 20.

Bridge.—Wrought-iron bridge; also reflooring bridge. J. Hagerty, County Auditor, Cincinnati, O. Dec. 13.

Public Buildings.—Concrete work for U. S. building at Pittsburg, Pa. Iron work for U. S. building at Detroit, Mich. J. H. Windrim, Supervising Architect, Treasury Dept., Washington, D. C. Dec. 17.

Reservoir.—*Trinidad, Col.*—Storage reservoir, 71,000,000 galls. capacity. N. W. Wall, City Engineer. Everett Bell, City Clerk. Dec. 10.

Bonds.—*Brooklyn, N. Y.*—Improvement bonds, $650,000. T. F. Jackson, Comptroller. Dec. 9.

Sewer.—*Denver, Col.*—Materials and construction. F. B. Crocker, President of Board of Public Works. Dec. 19.

Street Work.—*New York, N. Y.*—Flagging, curbing and grading. Department of Public Works, 31 Chambers St. Dec. 10.

Brooklyn, N. Y.—Belgian block paving and blue stone curb. Commissioner of City Works. Dec. 15.

Kansas City, Mo.—Stone, artificial stone, or artificial stone hexagon block sidewalks. E. Butts, City Engineer. Dec. 11.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Schenectady Locomotive Works, of Schenectady, N. Y., have recently completed another ten-wheel passenger compound locomotive for the Michigan Central R. R.; cylinders, 20 and 29 ins. by 24 ins., 74-in. driving wheels, weight, 135,000 lbs. The Baldwin Locomotive Works, of Philadelphia, Pa., have an order for 8 engines for the Chicago & Eastern Illinois R. R.; they have completed 2 ten-wheel engines for the Port Townsend Southern R. R. and 8 engines (including one compound) for the Mexican National Ry. The Rhode Island Locomotive Works, of Providence, R. I., are building a passenger compound engine with cylinders 18 and 28 ins. by 24 ins., driving wheels, 6 ft. 6 ins. diam.; they are also completing an order for 50 ten-wheel engines for the Union Pacific Ry., and have completed 5 six-wheel switch engines for the Ohio & Mississippi Ry. The Brooks Locomotive Works, of Dunkirk, N. Y., have built 2 mogul freight engines for the Flint & Pere Marquette R. R. The Canadian Locomotive & Engine Co., of Kingston, Ont., is building 4 heavy tank engines for the Chignecto Ship Ry., 10 mogul engines for the Grand Trunk Ry., and 5 engines for the Canadian Pacific Ry.

Cars.—The Lafayette Car Works, of Lafayette, Ind., are building 325 tank cars for the American Cotton Oil Co. The St. Charles Car Co., of St. Charles, Mo., has built a passenger car with special ventilating appliances for the Rio Grande Western Ry.; it has also delivered 12 passenger cars, equipped with the Boyden air brake, to the Jacksonville Southeastern R. R. The Haskell & Barker Car Co., of Michigan City, Ind., has a contract for 300 box cars for the Evansville & Terre Haute R. R. Three new mail cars of the standard U. S. design have been built at the West Albany shops of the New York Central & Hudson River R. R.; they are to run between New York and Chicago.

Car Works.—The Blondell Mfg. Co., of Baltimore, Md., with a capital stock of $200,000, proposes to erect works at Baltimore for the manufacture of horse, electric and cable cars. The directors are J. M. Blondell, T. E. Hambleton and W. A. House. Proposals for the purchase of the works and plant of the Indianapolis Car & Mfg. Co. will be received until Dec. 18 by Matthew Henning, receiver, Indianapolis, Ind.; the works use natural gas for fuel and have a capacity of 25 cars per day.

Driven Wells.—The Hydraulic Contracting Co., New York, has recently completed driven well plants for the Greenwich Electric Light Co., yielding 180 galls. per minute; the Passaic Electric Light Co., 100 galls.; the Newark Consumers Ice Co., Newark, N. J., 400 galls.; also in New York City, for M. Zimmerman, 40 galls. per minute; Colgate & Co., 20 galls.; Hall Steam Power Co., 25 galls.

The Wrought Iron Bridge Co., of Canton, O., is building a 500-ft. bridge with 2 spans across the Tippecanoe River, at the Monticello paper mills, Ind.; also a 450 ft. bridge in Morgan Co., Ind. A number of contracts for smaller bridges are reported. W. W. Winslow is the company's agent at Indianapolis.

Electric Crane.—An overhead traveling electric crane, with a capacity of 20 tons, has been put in at the Thomson-Houston works at Lynn. It has a span of 45 ft. and travel of 150 ft., and was built by the Morgan Engineering Works, of Alliance, O. It is operated by three Thomson-Houston motors of 10 HP., one for each direction of service.

Railway Clock.—A railway registering clock has been patented by J. A. Smith and John Dale. It is fitted with a track connection, and as each train passes the hands are moved automatically to indicate the time. Some of these clocks are said to be in operation near St. Paul, Minn.

Cement.—A tract of 1,200 acres of cement land, near Mitchell, So. Dak., is said to have been purchased by L. J. Petit for $20,000. The cement rock is considered as good as that at Yankton, where a Milwaukee company already has mills.

Dry Dock.—A dry dock is to be built at Port Townsend, Wash., by the Puget Sound Dry Dock Co. It is to be 1,000 × 325 ft., and is to be completed by the end of 1891. Mr. R. W. DeLion is interested.

Rail Joint.—The Weber rail joint is being tried on the New Jersey Central R. R. and the New York, New Haven & Hartford R. R.

New Companies.—St. Louis Car Coupler Co., of St. Louis, Mo.; to manufacture a solid steel coupler; President, W. V. Wolcott, Henry O'Hara, Geo. A. Bannatine; capital stock, $2,000,000. Picard Bridge Gate Co., of Chicago, Ill.; incorporators, Napoleon Picard, A. Picard, Louis J. Dennis; capital stock, $100,000. Love Electric Traction Co., of Chicago, Ill.; incorporators, John C. Love, H. N. Hibbard, A. G. Wheeler; capital stock, $100,000. Meter & Register Co., of Chicago, Ill.; incorporators, D. E. Felt, G. W. Martin, and C. J. DeBerard; capital stock, $500,000. Keystone Light & Heat Co., Covington, Ky.; incorporators, Andrew J. English, Powel Crosley; capital stock, $1,000,000. Rapid Safety Filter Co., Portland, Ore.; directors, Hy. Ackerman, Wm. Wadhams, and C. F. Patterson. Franklin-Richardson Co., Chicago, Ill.; to manufacture railway appliances; incorporators, Philip Clark, K. Franklin Peterson, J. R. Billings; capital stock, $50,000. Universal Power Co., Chicago, Ill.; to manufacture motor cars and railway appliances; incorporators, Joseph W. Lithgow, A. A. Osgood, G. B. Johnson; capital stock, $1,000,000. Simond Steel Mfg. Co., Pittsburg, Pa.; incorporators, Geo. W. Simond, Chas. B. McLean and O. C. Pudan; capital stock, $50,000. Single Rail & Saddle Car R. R. Co., of Union, Ore.; to manufacture a railway invented by J. B. Mahana, of Union. Emerson Car Co., of Charleston, S. C.; President, A. S. Emerson; Secretary, J. R. Smith; capital stock, $300,000. Gennet Air Brake Co., of Chicago, Ill.; incorporators, David Walloch, P. Opper, M. L. Rothschild; capital stock, $800,000. Independent Cement Co., of New Albany, Ind.; incorporators, A. P. Hauss, J. P. Nicholson, C. D. Nicholson; capital stock, $100,000.

Norwood Car Replacer.—A test of this device, manufactured by the Norwood Car Replacer Co., of Baltimore, Md., was made at Baltimore on the B. & O. tracks, Nov. 29. A gondola car loaded with paving blocks and weighing 95,000 lbs., was derailed at the point of a slight curve, which had a tendency to slew the tracks from the rails, and was then easily pulled over the replacers onto the track. The special features of the Norwood replacer are the extension or guard rail, a clamp instead of wooden brace for the inside frog, and the manner of adjusting the clamp on the outer frog; the rise is only enough to allow the wheel flange to clear the top of the rail.

Metal Market Prices.—*Rails.*—New York: $28.50 to $29; old rails $22.50 to $23 for iron and $20 for steel. Chicago: $31 to $31.50; old rails, $25 for iron and $16 to $19.50 for steel. Pittsburg: $29 to $29.50; old rails, $27.50 to $28 for iron, and $18 to $19 for steel.

Foundry Pig-iron.—New York: $16.50 to $18. Chicago: $15 to $17. Pittsburg: $15 to $17.25.

Track Materials.—New York: steel angle bars, $1.70 to $1.75; spikes, $1.95 to $2.05; track bolts, 2.75 to 3 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.95 to 2.05 cts. for iron, 2 to 2.1 cts. for steel; spikes, 2.15 cts.; track bolts, 2.9 with square, and 3 cts. with hexagon nuts. Chicago: splice bars, 2.05 to 2.1 cts. for iron and 2.15 to 2.20 for steel; spikes, 2.25 to 2.3 cts.; track bolts, 3.10 to 3.15 cts. with hexagon nuts.

Pipe.—Cast iron, $27 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 47½ and 40 per cent. on black and galvanized butt-welded; 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—New York, 4.60 to 4.70 cts. Chicago, 4.50 cts. St. Louis, 4.45 cts.

Structural Material.—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2.15 to 2.30 cts.; tees, 2.65 to 2.75 cts.; sheared iron plates, 2.15 to 2.25 cts.; steel plates, 2.35 to 2.50 for tank, 2.6 to 2.7 cts. for shell, 2.85 to 3 cts. for flange, 3.75 to 4.25 cts. for firebox. Chicago: beams, 3.2 cts.; angles, 2.35 to 2.4 cts.; tees, 2.9 to 3 cts.; universal plates, 2.45 to 2.5 cts.; sheared plates, 2.5 to 2.6 cts. for iron and 2.6 to 2.7 cts. for steel. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2.3 cts.; tees, 2.85 cts.; universal iron plates, 2.3 cts.; sheared steel bridge plates, 2.65 to 2.7 cts.; refined bars, 1.9 to 2 cts.; steel plates, 2.4 cts. for tank, 2.8 cts. for shell, 3 cts. for flange, 4 to 4.5 cts. for firebox.

Proposals for Bonds.

The City of Hallettsville, Lavaca county, Tex., will receive bids for $16,500 6% 50-year bonds, with privilege of redeeming at the expiration of 25 years, up to Dec. 1, 1890. Further information can be obtained by corresponding with WM. BLAKESLEE, City Clerk.

JESSE GREEN, Mayor. 47-3t

Long Leaf Yellow Pine.

For bridges, trestles, and car building. Mills in belt of the finest South Georgia yellow pine timber. Orders promptly filled. Address, C. J. HADEN,

Secretary and General Manager, Hosch Lumber Co., Clark Lumber Co.

Atlanta, Ga.

To Civil Engineers.

THE MUNICIPAL OFFICES,
ST. JOHN'S, N. F., Nov. 12, 1890.

CITY OF ST. JOHN'S, NEWFOUNDLAND.

Applications for the position of Town Engineer will be received by the undersigned up to the 18th day of December next. Applicants are required to state the salary they expect and give a concise epitomé of their professional experience and municipal works on which they have been engaged. Not more than five testimonials to accompany each application.

Traveling and personal expenses to St. John's will be paid by the Municipal Council. Salary will commence from date of arrival in St. John's.

P. W. KELLY,
48-2t Secretary Municipal Council.

Artesian Well.

Proposals are invited for sinking an artesian well at Americus Ga. Two flowing wells in city at same level. For particulars address

J. B. FELDER, Mayor,
48-2t Americus, Ga.

Toronto Street Railway.

Sealed tenders addressed to the undersigned will be received by registered letter at the office of the City Clerk, Toronto, Can., up to noon on the 15th day of January, 1891, for the purchase or lease of the street railway tracks in the city of Toronto, with or without real estate, buildings, rolling stock and all material used in connection with the said railway, together with the exclusive right of operating the said railway on the streets of the city of Toronto. For further particulars and conditions of sale, apply after Dec. 1, 1890, to W. T. JENNINGS, City Engineer, Toronto, Can.

MILES VOKES,
Chairman Street Railway Committee.
TORONTO, Can., Nov. 19, 1890. 48—

Proposals for Vertical Pumps.

Sealed proposals will be received at the office of the Board of City Affairs, Cincinnati, O., until 12 o'clock noon of December 26, A. D. 1890.

For four vertical pumps of 5,000,000 capacity each in 24 hours. These pumps to take the place of similar size Wetherill pumps now in position, and to operate by the steam ends now in use. Each bidder is requested to examine and measure the well, and so design his work as to properly connect with the parts to be retained.

Each bidder will be allowed to furnish his own plan, drawings and specifications, with guarantee as to date of completion, and forfeiture for failure in time. Also, will be required to give proposition on plans and specifications furnished by the Board of City Affairs.

For particulars apply to Willis P. Tharp, Superintendent and Engineer of Cincinnati Water-Works.

The Board of City Affairs reserves the right to reject any or all bids.

By order of the Board of City Affairs.

THOMAS G. SMITH,
President.

Attest: D. W. BROWN, Clerk B. C. A.
48-4t.

PROPOSALS FOR IMPROVING ENtrance to Galveston Harbor. U. S. Engineer Office, Galveston, Tex., Oct. 25, 1890. Sealed proposals, in duplicate, will be received at this office until 12 o'clock, noon, 90th Meridian time, Dec. 27, 1890, and then opened, for delivery of materials in place for improving the entrance to Galveston Harbor, Tex. Preference will be given to materials of domestic production or manufacture, conditions of quality and price (import duties included) being equal. The attention of bidders is invited to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, U. S. Statutes at Large. For blank forms for proposals and all necessary information, apply to CHAS. J. ALLEN, Major, Corps of Engineers. 44—3t 51—1t

S. E. NOBLE, Prest. JNO. E. WARE, Secy. and Treas. R. F. CARTER, Supt.

The Anniston Pipe Works,

MANUFACTURERS OF

CAST IRON WATER AND GAS PIPE,

ANNISTON, - - - - - ALA.

Especially adapted for the Elevation of Clear, Gritty, Thick, or Acidulous Liquids, Quickly, Cheaply and Efficiently

THE NEW PULSOMETER STEAM PUMP.

without Engine, Machinery, Oil, Expensive Power, Skilled Labor, or Material Wear. Send for Illustrated Catalogue.

PATENTED U. S. AND CANADA.

PULSOMETER STEAM PUMP CO., 120 Liberty St., New York.

MONTAGUE & CO.,

MANUFACTURERS

FIRE BRICK, SEWER PIPE,

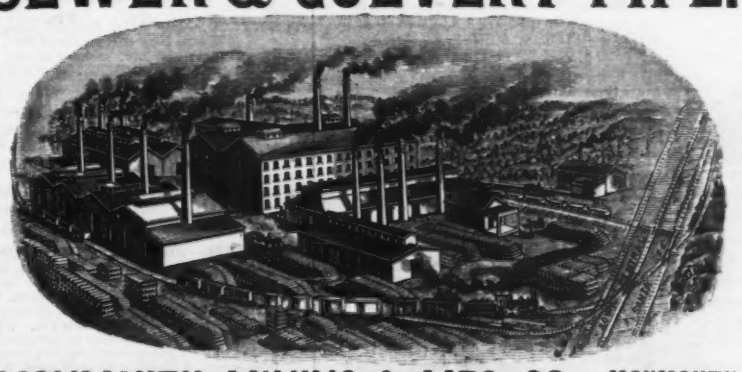
DOUBLE STRENGTH

RAILROAD CULVERT PIPE,

With long sockets, in two and one-half foot lengths.

CHATTANOOGA, - - - TENN.

DOUBLE STRENGTH SEWER & CULVERT PIPE.



MONMOUTH MINING & MFG. CO., MONMOUTH, ILL.

U. S. ENGINEER OFFICE, WILMINGton N. C., Nov. 6, 1890.—Sealed proposals for sheet piling, stone, mattresses, etc., in place in dike in Winyaw Bay, S. C., are to be received at this office until 12 M., Dec. 15, 1890. The attention of bidders is specially invited to Acts of Congress, approved Feb. 26, 1885, and Feb. 23, 1887, vol. 23, p. 332, and vol. 24, p. 414, Statutes at Large. All information furnished by W. H. BIXBY, Capt. of Engineers. 46-4t

BREAKWATER AT PORTCHESTER Harbor, N. Y., and at Larchmont Harbor, N. Y. Engineer Office U. S. Army, Room 74, Army Building, 39 Whitehall street, New York, N. Y., Nov. 15, 1890. Sealed proposals in triplicate for construction of breakwaters at Portchester Harbor, N. Y., and at Larchmont Harbor, N. Y., will be received at this office until twelve (12) o'clock noon on Monday, Dec. 15, 1890. The attention of bidders is invited to acts of Congress approved Feb. 6, 1885, and Feb 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. Further information can be obtained at this office. Applications should be indorsed on envelope "Applications for specifications." D. C. HOUSTON, Colonel of Engineers. 46-4t

EXTENSION OF BREAKWATER AT Glen Cove, N. Y. Engineer Office U. S. Army, Room 74, Army Building, 39 Whitehall street, New York, N. Y., Nov 15, 1890. Sealed proposals in triplicate for extension of the breakwater at Glen Cove, N. Y., will be received at this office until twelve (12) o'clock noon on Monday, Dec. 15, 1890. The attention of bidders is invited to acts of Congress approved Feb, 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. Further information can be obtained at this office. Applications should be indorsed on envelope "Applications for Specifications." D. C. HOUSTON, Colonel of Engineers. 46-4t

U. S. ENGINEER OFFICE, BURLINGTON, Vt., Nov. 13, 1890. Sealed proposals, in duplicate, addressed to the undersigned, will be received at this office until 11:30 o'clock A. M., Dec. 15, 1890, and then publicly opened, for furnishing 1,610 cu. yds. of rubble stone, 1,783 cu. yds. of large stone (one to three tons weight) and completing the continuation of 135 lin. ft. of extension to the breakwater at Gordon's Landing, Lake Champlain, Vt. Attention is invited to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. Detailed information can be had on application. M. B. ADAMS, Major of Engineers. 46-2t—49-1t

U. S. ENGINEER OFFICE, WILMINGton N. C., Nov. 6, 1890.—Sealed proposals for dredging in the Cape Fear River at and below Wilmington, N. C., and Lockwood's Folly River, N. C., will be received at this office until 11 A. M., Dec. 15, 1890. The attention of bidders is specially invited to Acts of Congress, approved Feb. 26, 1885, and Feb. 23, 1887, vol. 23, p. 33, and vol. 24, p. 414, Statutes at Large. All information furnished by W. H. BIXBY, Capt. of Engineers. 46-4t

EXTENSION OF BREAKWATER AT mouth of the Housatonic River, Connecticut. Engineer Office U. S. Army, Room 74, Army Building, 39 Whitehall street, New York, N. Y., Nov. 15, 189. Sealed proposals, in triplicate, for extension of the breakwater at the mouth of the Housatonic River, Connecticut, will be received at this office until twelve (12) o'clock noon, on Monday, Dec. 15, 1890. The attention of bidders is invited to acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. Further information can be obtained at this office. Applications should be indorsed on envelope "Applications for Specifications." D. C. HOUSTON, Colonel of Engineers. 46-4t

U. S. ENGINEER OFFICE, BURLINGTON, Vt., Nov. 20, 1890.—Sealed Proposals, in triplicate, addressed to the undersigned, will be received at this office until 11:30 o'clock A. M., Dec. 23, 1890, and then opened, for dredging 10,000 cu. yds., more or less, from Ticonderoga River, New York, and 20,000 cu. yds., more or less, from Otter Creek, Vermont, and depositing the dredged material in deep water of the lake; 2 miles average haul at Ticonderoga River and 4 miles at Otter Creek. Attention is invited to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. Detailed information can be had on application to this office. M. B. ADAMS, Major of Engineers. 49-2t, 51-1t

ENGINEER OFFICE, U. S. ARMY, NEW port, R. I., Nov. 24, 1890. Dump scows of 200 to 800 cubic yards capacity, wanted for use on the improvement of Hyannis Harbor, Mass., and elsewhere. Parties having them to let can obtain full information by addressing the undersigned. Their attention is invited to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, vol. 23, page 332, and vol. 24, page 414, Statutes at Large. W. R. LIVERMORE, Major of Engineers. 48-4t

City Arms—Notice to Contractors —Sewer Pipe.

Tenders will be received by registered post, addressed to the City Engineer, Toronto, up till noon on Tuesday, 23d December, for supply of pipe for year ending 31st December, 1891.

Approximate quantity required:

PIPE.

6-in. pipe	35,000 ft.	18 in. pipe	500 ft.
6-in. bends	200	18 × 6-in. junctions	20
9-in. pipe	5,000 ft.	18 × 9-in. junctions	40
9-in. bends	100	1 ft. 2 in. × 1 ft. 9 in. tile invert	2,000 ft.
12-in. pipe	12,000 ft.	2 ft. × 3 ft. tile invert	3,000 ft.
12 × 6-in. junctions	800	6-in. stoppers	800
12 × 9-in. junctions	200	9 in. stoppers	200
15-in. pipe	3,000 ft.		
15 × 6-in. junctions	200		
15 × 9-in. junctions	100		

Specifications and forms of tender can be obtained on and after the 1st of December at the City Engineer's office.

A deposit in the form of a marked cheque, payable to the order of the City Treasurer, for the sum of 2½% on the value of the work entered for must accompany each and every tender, otherwise it will not be obtained. All tenders must bear the bona fide signatures of the contractor and his sureties (see specifications), or they will be ruled out as informal.

The committee do not bind themselves to accept the lowest or any tender.

JOHN SHAW, Chairman,
Committee on Works.

COMMITTEE ROOM, Toronto, Canada,
Nov. 26, 1890. 48-2t

WRECK OF SCHOONER "S. S. BICKmore," Engineer Office, U. S. Army, Newport, R. I., November 26, 1890. To whom it may concern: Whereas, navigation is obstructed and endangered by the wreck of the schooner "S. S. Bickmore," lying about halfway between the wharf and the west end of the breakwater in Hyannis Harbor, Mass.; notice is hereby given to all persons interested in said vessel, her cargo and all other property therein, that if, within thirty (30) days from the date of this advertisement, they shall not have signified to me their intention and taken preliminary steps to remove said wreck, etc., as soon as practicable, the same will be considered as abandoned and derelict, and it will be removed by the United States under authority of law. Sealed proposals in triplicate for the removal of said wreck will be received at this office until 12 o'clock noon, on Saturday, the 27th day of December, 1890, and then opened. The attention of bidders is invited to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. The United States reserves the right to reject any or all proposals and to waive any informalities. Full information furnished on application. By authority of the Secretary of War. W. R. LIVERMORE, Major of Engineers. 48-4t

UNITED STATES ENGINEER OFFICE, 34 West Congress street, Detroit, Mich., Nov. 28, 1890. Sealed proposals, in triplicate, for furnishing all materials and labor and building the masonry of a lock at St. Mary's Falls Canal, Michigan, will be received at this office until 2 o'clock P. M., Jan. 27, 1891, and then publicly opened. Preference will be given to materials of domestic production or manufacture, conditions of quality and price (import duties included), being equal. Attention is invited to Acts of Congress approved Feb. 26, 1885, and Feb 23, 1887, vol. 23, page 332, and vol. 24, page 414, Statutes at Large. The Government reserves the right to reject any or all proposals; also to award the contract upon other considerations than the price. For further information apply at this office, or to the U. S. Engineer Office, Sault Ste. Marie, Mich. O. M. POE, Colonel, Corps of Engineers, Lvt. Brig.-Gen. U. S. A. 48-6t.

U. S. ENGINEER OFFICE, ROOM 90, 134 Van Buren St., Chicago, Ill., Nov. 24, 1890. Sealed proposals in triplicate, for rebuilding superstructure over 5,243 ft., more or less, of breakwaters in Chicago Harbor, Ill., will be received at this office until 12 o'clock noon, Saturday, Dec. 13, 1890, and opened immediately thereafter in the presence of bidders. Proposals will be accompanied by a guarantee that if the bid be accepted contract will be entered into within 10 days after notice of acceptance. The United States reserves the right to reject any or all bids. The attention of bidders is invited to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, p. 332, and Vol. 24, p. 414, Statutes at Large. Preference will be given to articles of domestic production or manufacture, conditions of quality and price (including in the price of foreign articles the duty thereon) being equal. No contract will be awarded for furnishing foreign articles when the domestic article of suitable quality can be obtained. For specifications, blank proposals and all other information, apply at above address to CAPTAIN W. L. MARSHALL, Corps of Engineers, U. S. A. 48-2t

U. S. ENGINEER OFFICE, CHARLESton-Kanawha, W. Va., Nov. 3, 1890. Proposals for building the foundations and the pier, abutment, etc., for a movable dam at lock No. 8 of the Great Kanawha River Improvement, will be received at this office until 3 P. M. of Dec 19, 1890, and then opened. The attention of bidders is called to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. Information can be obtained by application to Addison M. Scott, Resident Engineer. WM. P. CRAIGHILL, Colonel of Engineers, U. S. A. 46-4t.

For other Proposals See Page XXI.

THE "WELLS LIGHT"

WALLWORK & WELLS' PATENTS. (Registered Title.)

USES KEROSENE OIL.

btainable Everywhere.

ESPECIALLY ADAPTED

—FOR—

CONTRACTORS' NIGHT-WORK.

800 and 2,000 CANDLE POWER

REQUIRES NO ENGINE OR AIR COMPRESSOR to drive it as "others do."

(Copy.)

SAVANNAH, AMERICUS & MONTGOMERY RAILWAY.
OFFICE OF THE CHIEF ENGINEER,
AMERICUS, Ga., Aug. 8, 1890.
R. E. HARDAWAY, Chief Engineer.

Messrs. Keegan & Halpin, 46 Washington Street, New York City:

DEAR SIRS: I used four of your lights for steam shovel work at night some time since and they gave entire satisfaction.

Yours very truly,
B. E. HARDAWAY, C.E.

(Copy.)

WEST VIRGINIA IMPROVEMENT CO.
WESTON, W. Va., June 24, 1890.

Messrs. Keegan & Halpin, 46 Washington Street, New York:

GENTLEMEN: Replying to your favor of 21st inst., the light you sent us has thus far given satisfaction, and I can see no chance for improvement in it.

Yours truly,
J. A. FICKINGER, Ch. Eng.

WRITE FOR CIRCULAR.

THE "WELLS LIGHTS"

Are in use on the following Railroads:

Pennsylvania,
Lehigh Valley,
Erie,
West Shore,
Del., Lack. & West.,
Norfolk & Western,
Atlantic Coast Line,
N. Y., Prov. & Bost.,
W. N. Y. & Penn.,
Michigan Central,
Union Pacific,
Southern Pacific,
And **40** others.

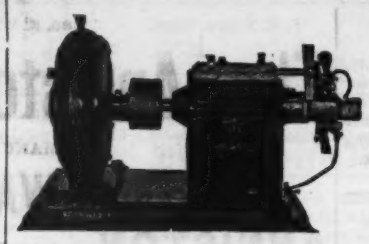
ALSO USED BY

Moffett, Hodgins & Clarke;
Washburne, Shaler & Washburne;
Carkin, Stickney & Crane;
C. H. & F. T. Dunbar;
Ryan & McDonald;
Prentice Brown Stone Co.;
Drake & Stratton;
Union Bridge Co.;
Berlin Bridge Co.,
And many others.

NEW HAND PATTERN WELLS LIGHT.
500 Candles, ¼ gall. per hour.

KEEGAN & HALPIN

44 and 46 WASHINGTON STREET NEW YORK.



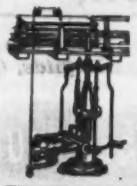
BELKNAP MOTOR CO.

Little Giant Water Motors,

Comb. Motors and Dynamos, Cyclone Coffee Mill, Electric Motors and Dynamos. Lighting Plants for Water-Works Pumping Stations a Specialty.

SEND FOR DESCRIPTIVE CIRCULARS.

PORTLAND, MAINE.



D. P. GOSLINE,

32 OLIVER STREET, BOSTON,

Successor to the BOSTON HYDRAULIC MOTOR CO.,

MANUFACTURER OF

Church Organ Blowing WATER MOTORS.

Correspondence Solicited. All Work Guaranteed.

SITUATIONS VACANT.

WANTED.—Two first-class draughtsmen experienced in bridge and roof details. Also, one first-class draughtsman experienced in fire-proof building construction. Permanent positions and good pay to thoroughly reliable men; no others need apply. Address IRON WORKS, care Engineering News. 46-4t

WANTED.—A first-class foreman for our general wrought iron shops. Must be thoroughly competent and experienced in iron and steel roof, truss and bridge work. Permanent position for the right man. Address, stating experience and references, SCHERPE & KOKEN ARCHITECTURAL IRON CO., St. Louis, Mo. 48-2t

WANTED.—One or two transitmen for laying out town sites in Virginia. Salary, $100 per month. Must provide transit. Apply, giving references, experience, etc., to C. E. C., care Engineering News. 49-1t

MISCELLANEOUS.

WANTED.—2,000 bbls. Portland cement, delivered on boat at New Orleans about Nov. 15. Tensile strength, 300 lbs. one day in air, six days under water. McCORMICK & O'MEARA, 904 Olive St., St. Louis, Mo. 40-

WANTED.—We will send a copy of "Cross' Engineer's Field Book" in exchange for ENGINEERING NEWS of Aug. 2, 1890. Address Engineering News.

WANTED.—Good transit. Must be cheap. A. B. WILL, Room 1, 91 Washington Street, Chicago, Ill. 48-3t

WANTED.—Draughtsman, thoroughly competent, quick, accurate, and reliable, desires a position in the North or West. Has had experience in railway location, on residency, sewerage and building construction. Can furnish A No. 1 references; married; 38 years old. At present located in South, but wishes to change on account of health. A permanent position more desired than salary. Address, with particulars, EXPERT, care of Engineering News. 47-4teow

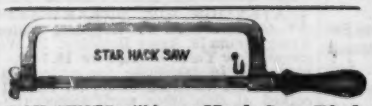
Engineer's Level, 20 in. telescope and compass, mounted by Gurley, with mahogany tripod, box, plumb bob; all complete; in first-class condition. Can be examined at the office of F. B. PATTERSON, 177 Broadway, Rooms 3 and 4. $70. 47-5t-eow

WANTED.—An experienced bridge draughtsman desires a situation. Can make strain sheets and calculate strains. Address DRAUGHTSMAN, care Engineering News. 49-1t

WANTED.—An engineer having 20 years' experience in the planning and construction of public improvements, water-works and sewers is open to an engagement. Can do any kind of draughting. Would like to make some arrangement with a large contracting firm, or to be principal assistant in charge of an engineer's office. Address B., care Engineering News. 49-1t

WANTED.—A college graduate having had three years' experience in ventilating and general steam contracting work desires a position. Address X. Y., care of Engineering News. 49-1t

WANTED.—Inspection of important bridge work from parties willing to pay for experienced engineer. INSPECTOR, care Engineering News. 49-3t



SIX CENTS will buy a **Hack Saw Blade** which will cut iron all day without sharpening, and on many kinds of work will do as much as $1 worth of files. Twelve cents will buy a butcher's saw blade which will cut bone four weeks without filing. Both kinds are tempered by a secret process which enables them to do five times as much work as any others in use. All saws marked with a star and bearing our name are fully warranted wherever bought. For sale by all hardware and supply dealers in this country and Europe.

Miller's Falls Company,
93 READE ST., NEW YORK.

ADVERTISE CONTRACT WORK

IN

ENGINEERING NEWS.

SITUATIONS WANTED.

WANTED.—An engineer who expects soon to finish his present engagement desires position on location, construction or maintenance of way. Twenty years experience; 40 years old. Address C. E., Engineering News. 36—

WANTED.—An engineer having charge of designing and superintending the ironwork for important fire-proof structures wishes to correspond with reliable parties to make a business combination, or would accept a salaried position for sufficient inducements. Is well acquainted with architects, engineers and contractors, and has had extended experience in estimating and soliciting contracts. RELIABLE, care Engineering News. 46-4t

WANTED.—As engineer or assistant on city or improvement work. Experience in Boston and the South. References given. Address E., care Carrier 193, Roxbury, Mass. 46-5t

WANTED.—By an engineer (graduate M. A. C., '78) with several years' experience in practical railroad work, a position upon survey, railroad construction or city work, South or West. J. F. HUNT, Sunderland, Mass. 47-3t

WANTED.—A position as engineer, superintendent, or assistant superintendent, if works are large, of a water-works system, by a young man, experienced in designing, building and maintaining such works. Good references as to character and ability. Address J. G., care of Engineering News. 48-3t

WANTED.—A situation by a young man of 28 with four years' experience in sewer construction and surveying. Address M. A. C., 87, care Engineering News. 49-1t

WANTED.—Young man would like position as rodman. Five years' experience. Locality no object. Can level. Address RODMAN, 36 Yale Ave., Sing Sing. 49-1t

WANTED.—Young civil engineer, with six years' experience on the design and construction of water-works, irrigation and sewerage works with first-class English firm of civil engineers, seeks appointment as assistant or resident engineer. Address CIVIL ENGINEER, P. O. Box 59, Brooklyn, E. D. 49-1t

WANTED.—A water-works engineer, aged 33, now acting as superintendent and of good address, responsible, energetic, understands water-works construction, steam and water-power pumping machinery; can prepare plans and make accurate estimates; can address a public meeting or canvass a committee; wants a position with a first-class firm of water-works contractors. Address CONTRACTING AGENT, care Engineering News. 49-2t

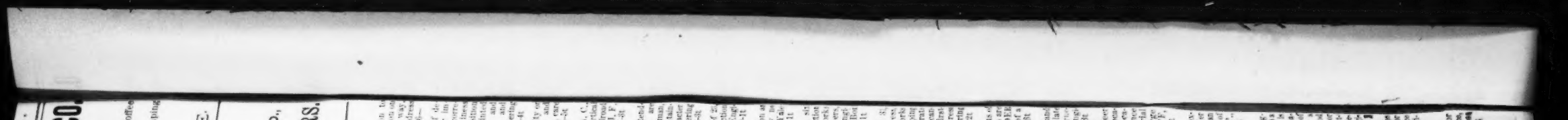
WANTED.—Manufacturers who are desirous of being represented in the Maritime Provinces are requested to correspond with ALEXANDER POTTER, Halifax, N. S., Acting Manager of a Manufacturers' Agency to open Dec. 1. 49-3t

WANTED.—Position by an experienced and capable draughtsman, up to the times on plate and structural work and blast furnace construction. Please address BROWNSON, care Engineering News. 49-3t

WANTED.—Employment by a locating engineer with 17 years' experience on surveys and the location of railroads. Age, 37. Having made location a business I think I can merit the confidence of those needing such work done. Give me a trial and if you are not suited with my work no charge will be made for my effort. Address H. SHOFF, Burlington, Kan. 49-3t

WANTED.—A draughtsman of some years experience in the U. S. Engineer Corps, under Gens. John Newton and Q. A. Gilmore, wants an engagement. A fine letterer. Specimens of work and testimonials furnished. Address E. P., at this office. 49-3t

WANTED.—A gentleman of known and recognized ability and of many years' experience as a gas and water supply engineer, and manager, is open for an engagement, either as general manager for a firm or syndicate operating a number of works, or as engineer and superintendent of a good water or gas plant; or would accept a good lucrative position with a manufacturer of water or gas works supplies. Has a very large acquaintance and is master of the business in all of its details. Address WATER AND GAS, care Engineering News. 49-3t

WANTED.—A position with engineering corps as transit observer or leveler, on preliminary or location, or as instrument man on maintenance of way. References. Address H., care Engineering News. 49-4t

WANTED.—Position on location, construction or maintenance of way. Fifteen years' experience, 37 years old, correct habits, graduate. Address C. E., 15, Engineering News. 49-4t